WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

155-MM GUN AND CARRIAGE M1 AND M1A1

April 27, 1942

TECHNICAL MANUAL

155-MM GUN AND CARRIAGE M1 AND M1A1

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, November 3, 1942.

TM 9–1350, April 27, 1942, is changed as follows:

7. Equilibrators.— * * *.

a. To check the nitrogen pressure.

* * * * * * *

(3) **In the event of a continuous pressure drop in either cylinder due to leaks,** soap suds should be applied to all thread connections * * * base shop for repair.

b. ***To charge the equilibrators with nitrogen.***—**Retract valve opener on the filling tube to prevent the escape of gas already in the equilibrator. Remove tee cap from filling tube, and attach flexible tube (C419, fig. 5). Connect flexible tube to nitrogen cylinder. Check to make sure air release valve is closed. Then screw in valve opener until the lifting of the equilibrator filling valve (fig. 11) from its seat can be felt. Open nitrogen cylinder valve slightly to allow gas to flow into equilibrator very slowly. Close nitrogen cylinder valve when the required equilibrator pressure is indicated on pressure gage. Retract valve opener to allow equilibrator valve to seat. Disconnect flexible tube and replace tee cap on filling tube. Again turn valve opener handle to open equilibrator valve and observe the pressure on the gage. If the pressure is greater than desired, open release valve and allow a slow escape of gas until the proper pressure is indicated, then reseat equilibrator valve. Remove air filling tube and replace closing plug. The pressure in both equilibrators should always be the same.**

c. To relieve accumulated air in the head.

* * * * * * *

[A. G. 062.11 (10–31–42).] (C 1, Nov. 3, 1942.)

By ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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U. S. GOVERNMENT PRINTING OFFICE: 1942

TECHNICAL MANUAL

155-MM GUN AND CARRIAGE, M1 AND M1A1

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON, May 28, 1943.

TM 9–1350, April 27, 1942, is changed as follows:

FIGURE 1.—155-mm gun recoil mechanism M3.

[A. G. 062.11 (5-5-43).] [As C 1, May 28, 1943.]

5. Recoil mechanism.

* * * * * * *

c. Oil reserve in the recuperator and proper functioning of oil index.—(1) The oil reserve (or reserve oil) * * * drop to zero. **A full reserve of oil constitutes 1 quart. When the regulator and floating piston are in contact as above, there is zero reserve oil present. The M3 oil pumps should be tested to determine the number of strokes required to pump 1 quart of oil. (One stroke is one complete cycle of the pump handle.) The oil index will reach its maximum point of movement at 60 or 70 strokes of the oil pump. This does not constitute a full reserve of oil, consequently pumping oil will continue until the number of strokes required to pump 1 quart of oil has been obtained.**

* * * * * * *

6. Manometer test.

* * * * * * *

b. Temperature.—At low temperatures * * * hours preceding test. **However, if circumstances are such that it is impossible to comply with these instructions, the following procedure may be used:**

(1) Make manometer test in the prescribed manner, for nitrogen pressure only.

(2) If adequate pressure is indicated, fire one service round, noting length of recoil and time of counterrecoil.

(3) If recoil mechanism functions satisfactorily with the exception of short recoil and slow counterrecoil, firing may proceed slowly until normal action is obtained.

c. Procedure.

* * * * * * *

529500—43

(6) *Measuring friction of recoil rod stuffing box, counterrecoil piston, and counterrecoil rod stuffing box.*

* * * * * * *

NOTE.—Exercise the counterrecoil rod * * * are well lubricated. The desired pressure necessary to overcome the combined friction is 200 psi. The friction should never be below 190 psi or above 350 psi.

* * * * * * *

d. To calculate nitrogen pressure.

* * * * * * *

(2) The correct pressure at any temperature * * * in table I. It will be noted that for each 5° F. change in temperature there is a corresponding change of 1.2 kg per sq cm (17.3 psi). The recoil mechanism is considered serviceable with a variation of plus or minus 6.84 kg per sq cm or 100 psi. If not within these limits, the recoil mechanism should go to a base shop.

TABLE I (Superseded)

Temperature (Degrees F.)	Pressure (Kg per sq cm)	Pressure (Psi)	Temperature (Degrees F.)	Pressure (Kg per sq cm)	Pressure (Psi)
5	112	1598	85	132	1872
10	113	1615	90	133	1889
15	115	1632	95	134	1906
20	116	1649	100	135	1922
25	117	1667	105	136	1940
30	118	1684	110	138	1957
35	119	1701	115	139	1974
40	121	1718	120	140	1992
45	122	1735	125	141	2009
50	123	1752	130	142	2026
55	124	1769	135	144	2043
60	126	1786	140	145	2060
65	127	1803	145	146	2077
70	128	1820	150	147	2094
75	129	1837	155	149	2112
80	130	1855			

e. To calculate friction of the floating piston.—The friction o * * * is 85.2 psi. The value of *F* should never be below 70 ps nor above 350 psi.

* * * * * * *

[A. G. 062.11 (5–5–43).] (C 2, May 28, 1943.)

15. Breech mechanism.

* * * * * * *

b. Primer failures.

(2) *Incorrect adjustment of firing pin protrusion.*—Disassemble the firing mechanism * * * a new pin. Assemble the mechanism and see that the firing pin **protrudes** 1/32 inch when the firing pin guide is pressed down completely. Test adjustment of * * * two service primers.

* * * * * * *

16. Recoil mechanism.—*a. Scope of maintenance by ordnance maintenance personnel.*—For the proper field maintenance of 155-mm gun recoil mechanism **M3,** ordnance maintenance personnel may dismount, disassemble, repair, * * * base repair shops.

* * * * * * *

APPENDIX

LIST OF REFERENCES

* * * * * * *

2. Explanatory publications.

f. Ordnance drawings.

* * * * * * *

155-mm gun carriage M1A1_____ Class 3, Division 185
155-mm gun recoil mechanism **M3**_____ Class 3, Division 186

* * * * * * *

[A. G. 062.11 (5-5-43).] (C 2, May 28, 1943.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
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U. S. GOVERNMENT PRINTING OFFICE: 1943

TECHNICAL MANUAL
No. 9–1350

WAR DEPARTMENT,
WASHINGTON, April 27, 1942.

ORDNANCE MAINTENANCE

155-MM GUN AND CARRIAGE M1 AND M1A1

SECTION I

GENERAL

1. Scope.—This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of the 155-mm gun and carriage M1 and M1A1, supplementary to those in the Field Manuals and Technical Manuals prepared for the using arm. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the matériel.

*This manual supersedes TM 9–1350, July 15, 1941.

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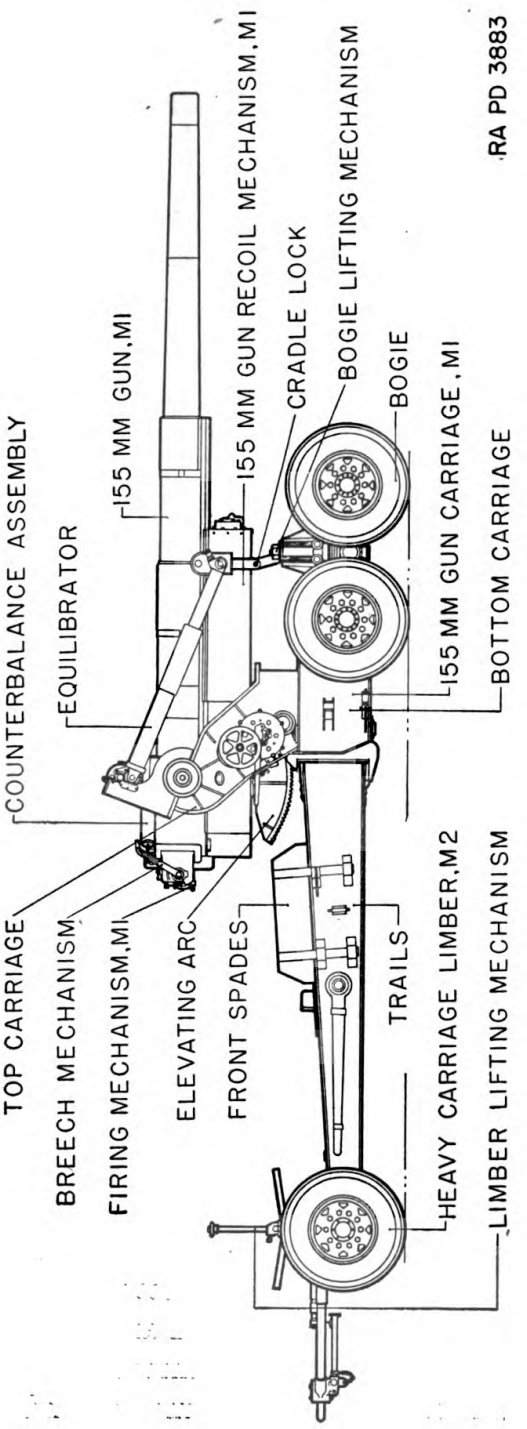


FIGURE 1.—155-mm gun matériel M1—right side elevation.

SECTION II

INSPECTION

2. General.—*a.* Inspection is undertaken for the purpose of determining the condition of the matériel; to find out if repairs or adjustments are required; and what precautions are necessary to insure that the matériel is in such serviceable condition that it will function properly. A record of all inspection and maintenance will be kept in the Artillery Gun Book, O. O. Form 5825. Instructions for the use of the gun book are outlined therein. (See also OFSB 4–1.)

b. Preliminary to the special inspection described herein, a routine inspection should be made as outlined in TM 9–350.

3. Tools.—The following tools of a special nature are used in inspection of 155-mm gun matériel M1 and M1A1 by ordnance maintenance personnel. They are included in the set of special repair tools listed in section I*b*, SNL D–14.

a. Chest, oil pump, M2, with contents.—Figure 2 shows the chest and equipment it contains. This apparatus is used in testing the recoil mechanism for nitrogen pressure and friction of recoiling parts. The equipment is used as follows:

(1) The oil screw filler (C73548) is used when the oil index of the recoil mechanism indicates that oil is required for a full reserve in the system.

(2) The ½-pint funnel (SFAX1B) is used when replenishing oil in the recoil cylinder.

(3) The oil pump M2A1 (D37652) is used to establish a full reserve of oil in the recoil mechanism when the oil has been released due to malfunction of the system.

NOTE.—Oil pump M3 will be issued in the future to replace the above pump.

(4) The filling and drain valve release (A1001) is used when necessary to fill or withdraw the reserve oil from the system.

(5) The flexible steel rule (B5757) is used to measure the quantity of oil in the replenisher system.

(6) The open end wrench (B167298) is used to loosen or tighten the pump and bolt sleeve nuts.

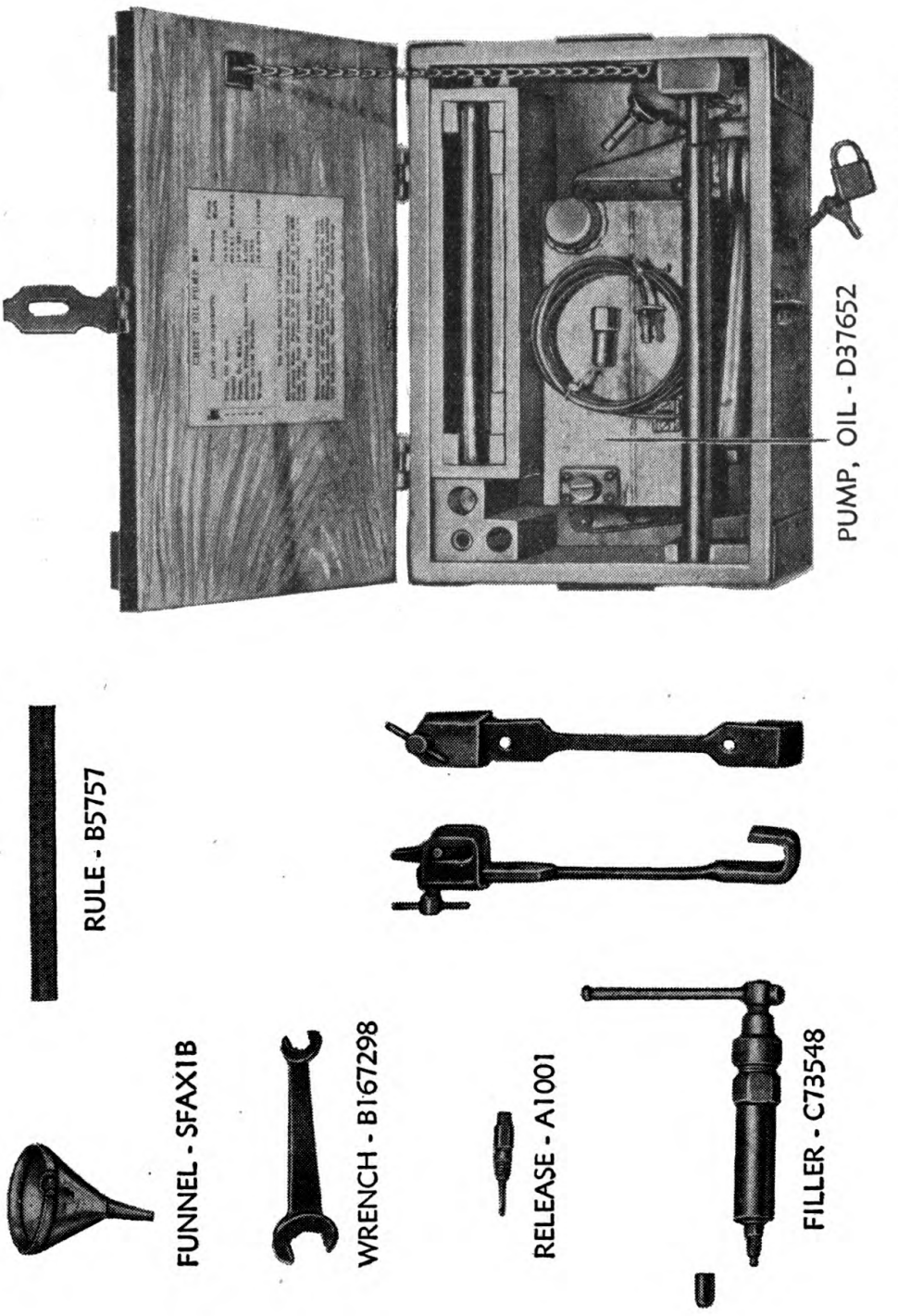


FIGURE 2.—Chest, oil pump M2, with contents.

b. Chest, pressure gage tester, with contents, complete.—(1) Apparatus carried in this chest (fig. 3) is used for testing the accuracy of the service pressure gage (C6385) with the master pressure gage (B748). The equipment consists of the tester, master gage, and the various tools, adapters and spare parts used therewith. The pressure gage tester is a tube with a connection at each end for the service and master gages. It is filled with liquid which can

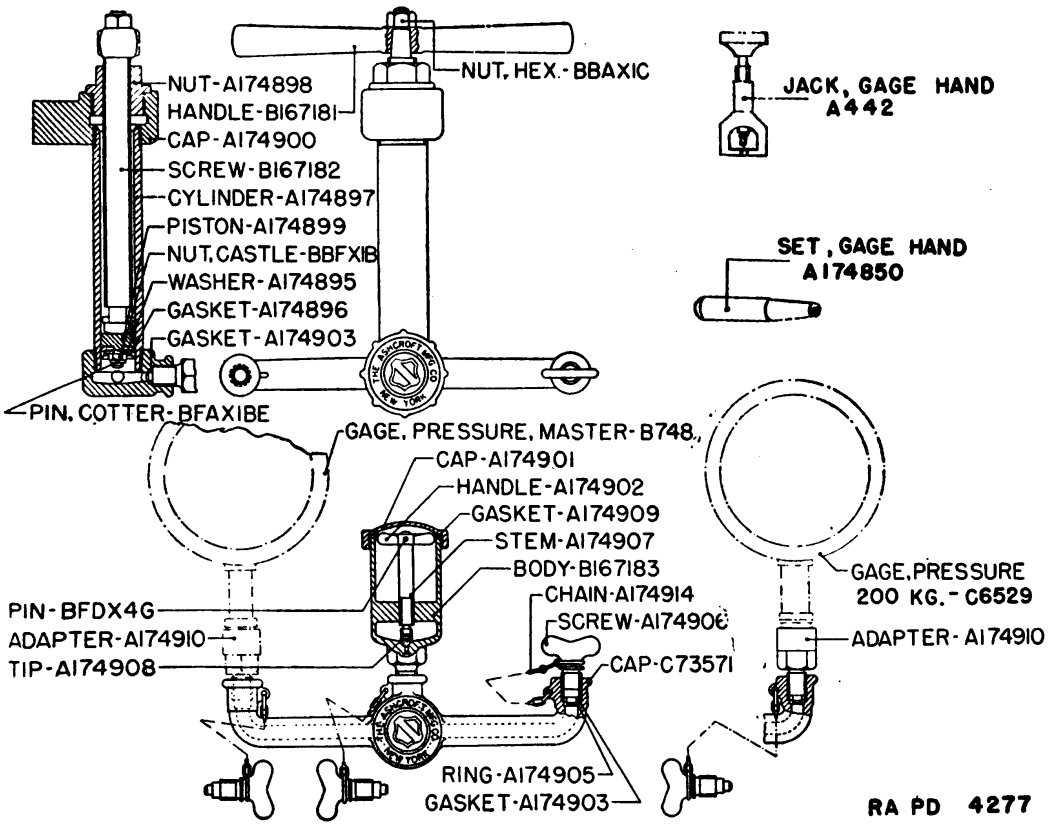


FIGURE 3.—Pressure gage tester.

be subjected to pressure by means of an operating screw pressure being transmitted equally to both pressure gages.

(2) To use the pressure gage tester, clamp it in a vise in the horizontal position. Fill the tester with oil, recoil, heavy. Attach the master pressure gage to one end of the tester and the service pressure gage to the other end. Apply pressure by means of the operating screw.

c. Gage, pressure, and connections, complete.—The pressure gage (fig. 4), with connections, is used in testing for pressure in the recoil mechanism.

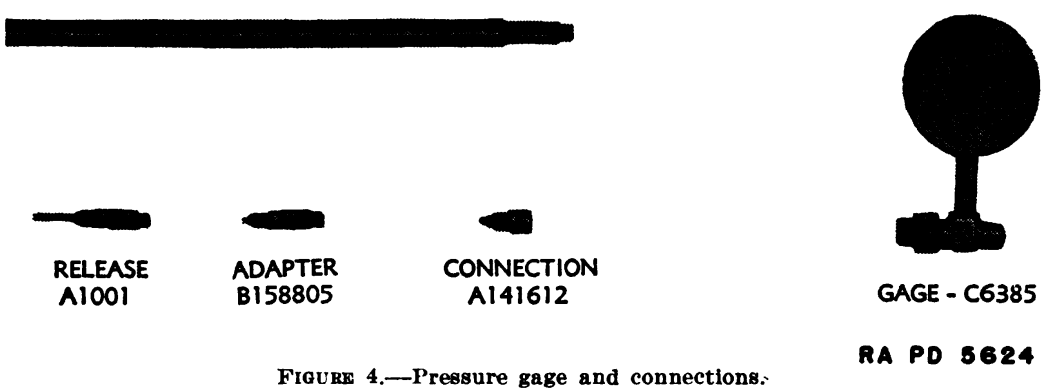


FIGURE 4.—Pressure gage and connections.

d. Jack, screw, recoil piston.—The recoil piston screw jack (fig. 5) is used to force the counterrecoil piston rod to the rear when testing the recoil mechanism for pressure.

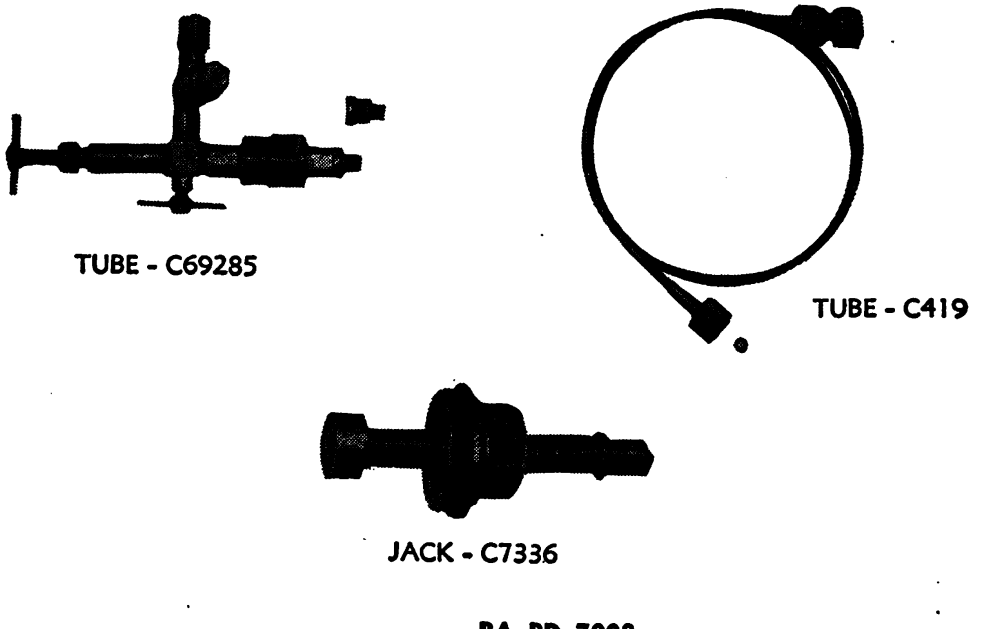


FIGURE 5.—Jack, recoil piston screw.

e. Tube, filling, air.—The air filling tube (C69285) is used in testing the nitrogen pressure in equilibrators.

f. Tube, filling, air, flexible.—The flexible air filling tube (C419) is used in conjunction with the air filling tube when testing the equilibrators for nitrogen pressures.

4. Bore.—*a.* The estimated average accuracy life in full service rounds of the 155-mm gun M1 and M1A1 is 2,000 rounds. Guns in service will be star-gaged at approximately 10 percent and 90

percent of their estimated average accuracy life in rounds fired, and thereafter at intervals of 10 percent of the original estimated life during the remainder of their service. They should also be star-gaged whenever an inspector deems it necessary because of doubtful condition, or when the bores show signs of unusual wear or other irregularities. Decoppering of the bores of cannon before star-gaging is prohibited. When star-gaging these guns, the greatest distance from the muzzle at which star-gage measurements are to be taken is 230.3 inches.

b. For pastilles or other defects of the bore of the gun requiring accuracy measurements, plaster of paris should be used if practicable, as it has a harder surface than gutta-percha and thus gives a more accurate measurement.

c. When a gun is to be stored for an extended period or to be shipped a long distance, especially if the voyage is over water, the bore should be coated with rust preventive as prescribed in TM 9–850. For ordinary protection the bore must be coated with oil, engine, SAE 10, for temperatures less than 32° F. and SAE 30 for temperatures greater than 32° F.

5. Recoil mechanism.—*a. General.*—(1) The recoil mechanism is inspected for—

(*a*) Oil leakage.
(*b*) Proper functioning of oil index.
(*c*) Serviceability of the replenisher.
(*d*) Leakage of nitrogen.
(*e*) Pressure of the compressed nitrogen.
(*f*) Friction of the various packings.
(*g*) Condition of the gun slides and cradle ways.

(2) Efficient functioning of the recoil mechanism depends upon—

(*a*) The proper "oil reserve" which is indicated by the oil index and position of the replenisher piston. It should be checked as outlined in *c* below.

(*b*) Proper friction of the recoiling parts and the proper nitrogen pressures which are checked by the manometer test. (See par. 6.)

(3) In the event of overrecoil, the reserve oil should be checked and a manometer test taken to check the nitrogen pressure and friction of the recoiling parts. Then if the reserve oil, pressure, and frictions prove to be correct, the recoil mechanism is out of order and should be reported to the Chief of Ordnance for disposition before any more firing is attempted.

b. Leakage of oil.—Remove the filling and drain plugs (B155851) (figs. 10 and 34) and examine for leakage of oil through the valves.

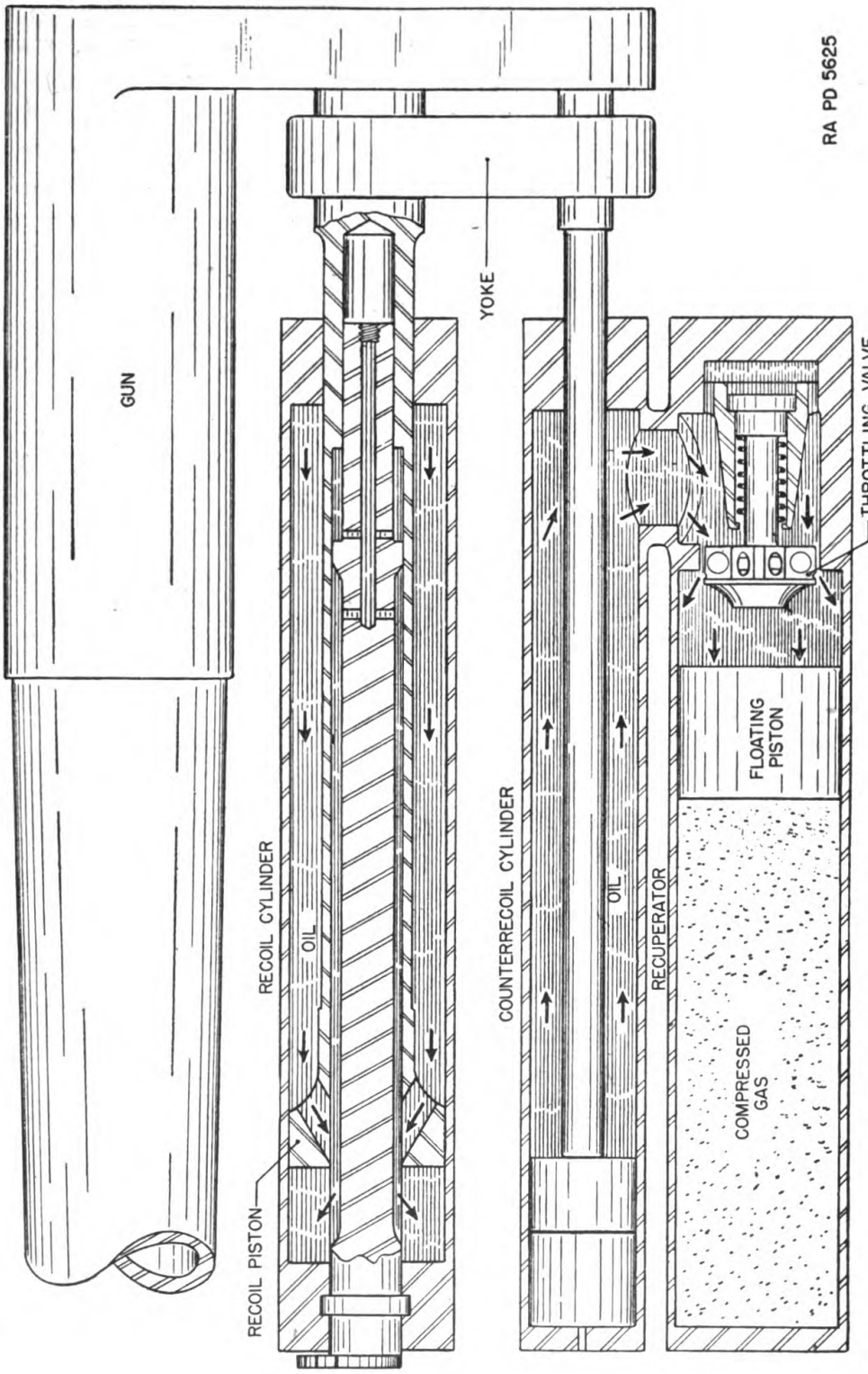


FIGURE 6.—Recoil mechanism—schematic drawing.

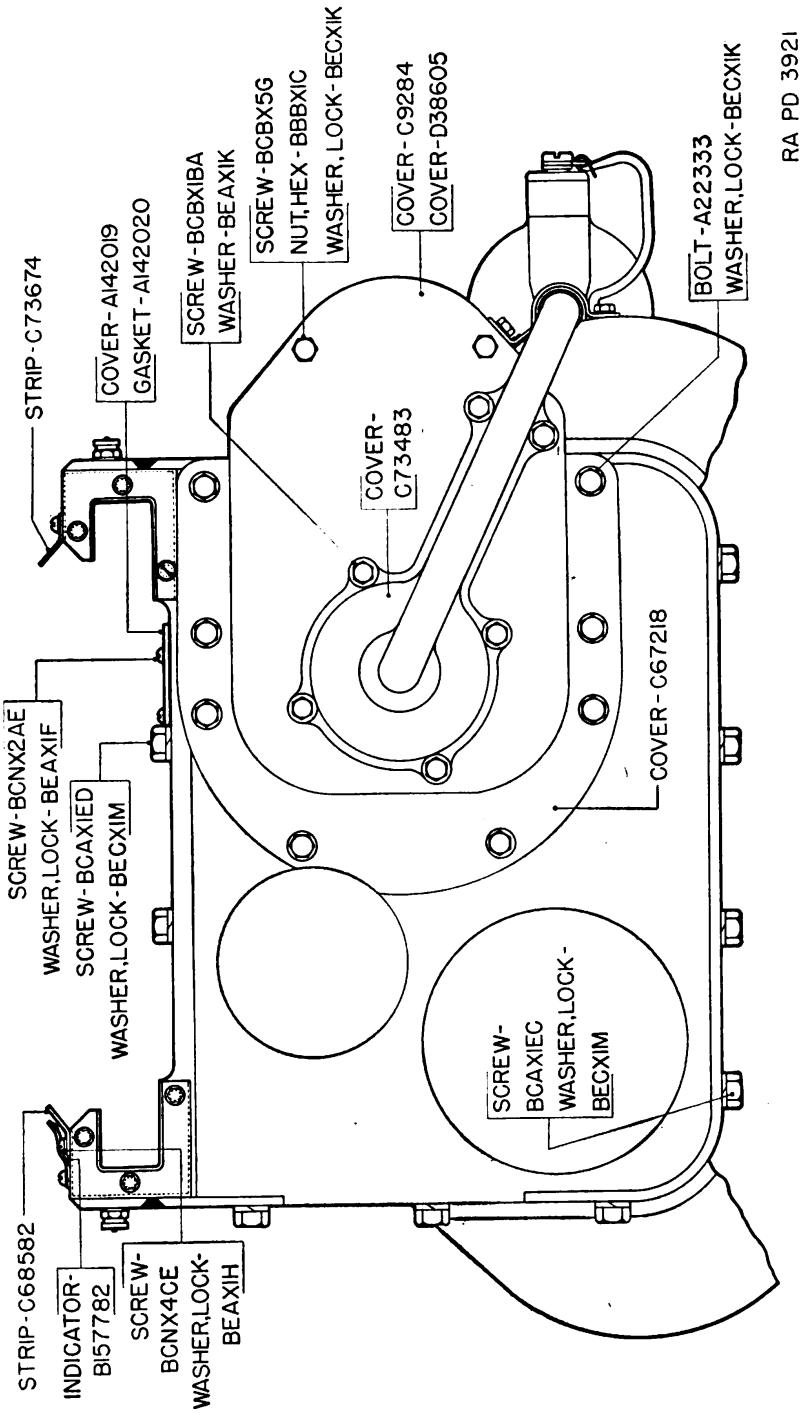


FIGURE 7.—Recoil mechanism—front view.

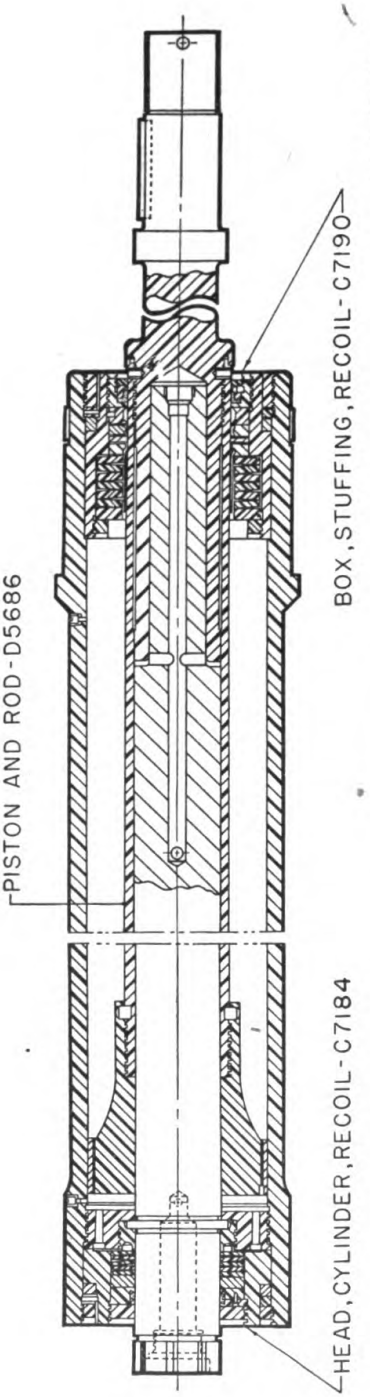


FIGURE 8.—Recoil cylinder.

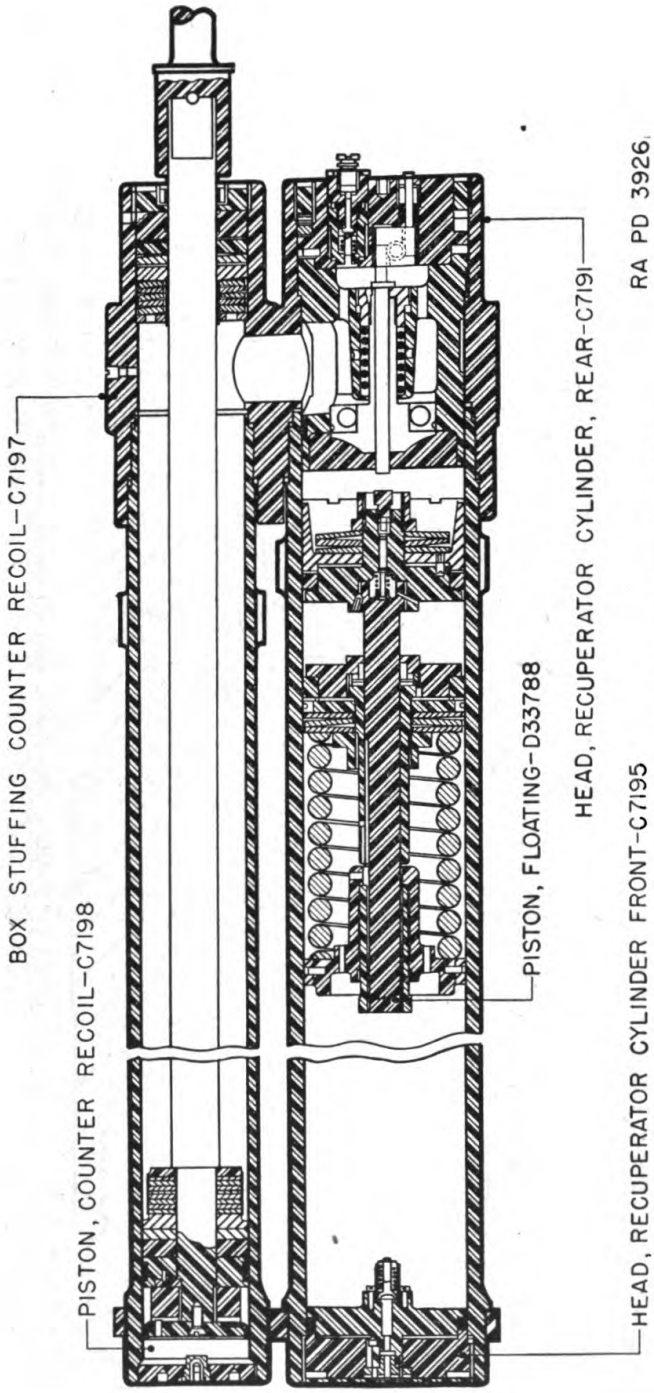
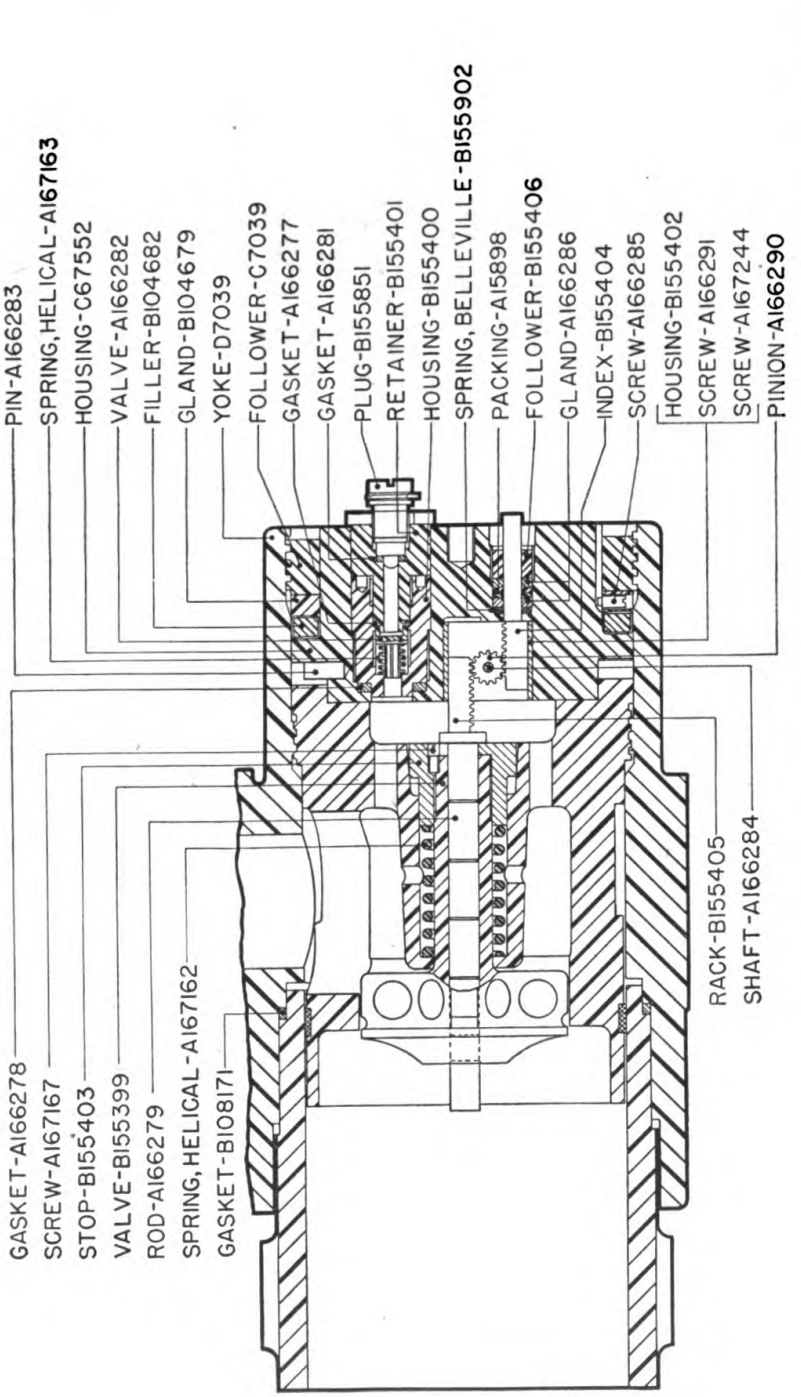
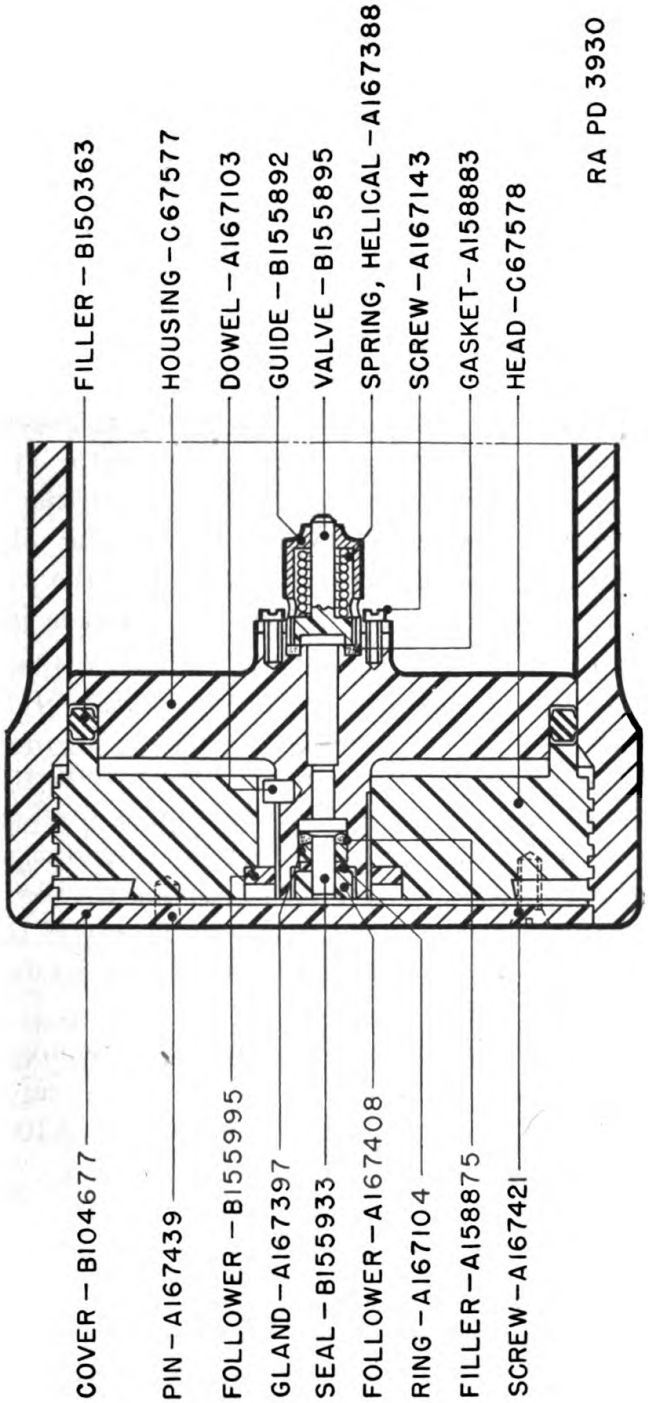


FIGURE 9.—Recuperator and counterrecoil cylinder.



① Rear head.



② Front head.

FIGURE 10.—Recuperator cylinder.

Remove the counterrecoil cylinder front head (fig. 9) and check for leakage around the counterrecoil piston. Examine the face of the counterrecoil cylinder rear head. Check the oil index, each end of the recoil cylinder, and each end of the replenisher cylinder for evidence of excessive leakage. Piston and stuffing box packings normally pass a small amount of oil which insures lubrication. A leak at any packing that does not exceed 3 drops per minute, immediately after firing, is not considered serious. A leak at any packing of an inactive recoil mechanism should not, however, exceed 1 drop in 2 minutes.

c. Oil reserve in the recuperator and proper functioning of oil index.—(1) The oil reserve (or reserve oil) is a term applied to that portion of the oil which normally separates the floating piston from the regulator. The compressed nitrogen acts to put pressure on the oil only as long as there is oil between the regulator and floating piston. After these components come in contact, further movement of the floating piston is prevented, so pressure on the oil will drop to zero. In amount, a full oil reserve constitutes the volume corresponding to the distance the oil index travels between its extremes of movement. This volume is 1 quart. When the regulator and floating piston are in contact as above, there is zero reserve oil present.

(2) If the oil index is binding, an incorrect indication of the amount of reserve oil may be given. If the gun is fired with either an excess or a lack of reserve oil, damage to the gun will result. Therefore, particular attention should be given to the oil index. When replenishing and releasing the reserve oil, note if the index is binding. If the index is binding and does not move its full distance it should be repaired.

(3) To establish oil reserve proceed as follows: Remove the filling and drain plug (B155851) (fig. 10) from the recuperator cylinder rear head (fig. 9) and insert in its place the oil release (A1001). Draw off the oil until the oil index stops moving.

(4) Remove the oil release and assemble the adapter (B158805) in its place. Attach the oil screw filler (or oil pump) to the adapter and purge the system.

NOTE.—"Purging" means removing all air from the line when forcing in the oil. This is done by loosening slightly one connection in the line, letting the air escape until no more air bubbles appear at the joint, then tightening the connection. Replace the oil until the oil index starts moving, then force in 1 quart of recoil oil (equal to 100 strokes of the oil pump (M2A1)) which is a full reserve. Remove the adapter and replace the filling and drain plug.

d. Reserve oil for the recoil cylinder and functioning of the replenisher.—(1) To test the operation of the replenisher, insert a scale through the opening of the replenisher piston guide against the replenisher piston. Then release oil by screwing the filling and drain valve release into the recoil cylinder drain hole. If movement of the replenisher piston takes place, it is working satisfactorily as a gage of the amount of oil in the recoil system.

(2) The position of the replenisher piston with respect to the rear face of the replenisher cylinder is used to determine the amount of reserve oil present for filling of the recoil cylinder. Normal distance of the replenisher piston from the rear face of the replenisher cylinder is 14.6 cm (5¾ inches). This position indicates that a normal reserve of oil is present in the replenisher. The position of the replenisher piston should be checked and when the piston is 10.2 cm (4 inches) or less from the rear face of the replenisher, oil should be removed from the recoil cylinder before firing is continued. When the replenisher piston has moved in to 20 cm (7⅞ inches) or more from the rear face of the replenisher, oil should be added.

e. Leakage of nitrogen.—If nitrogen leaks past the floating piston it may be detected by the sputtering and foamy appearance of the reserve oil when drained from the mechanism.

6. Manometer test.—*a. Purpose.*—The purpose of the manometer test is to—

(1) Obtain the nitrogen pressure.

(2) Obtain the friction of the floating piston.

(3) Determine the combined friction of the counterrecoil piston, counterrecoil piston rod stuffing box, and recoil rod stuffing box.

b. Temperature.—At low temperatures the oil in the mechanism becomes sluggish. This causes greater friction in the piston and stuffing box packings, and erratic action of the oil when passing through the small throttling orifices. Therefore nitrogen pressure measurements made with the mechanism at low temperatures are unreliable. If the pressure must be tested in cold weather, the mechanism and oil must be placed in a room warmed to at least 50° F. for 24 hours preceding the test.

c. Procedure.—(1) With the gun in battery at 0° elevation, remove the filling and drain plug from the replenisher. Insert the filling and drain valve release and draw off the oil in the replenisher. Remove the filling and drain valve release.

(2) Remove the filling and drain plug on the recuperator cylinder rear head (C7191) and connect the oil release to the end of the adapter (B105455). Draw off the reserve oil into a suitable receptacle.

NOTE.—Pressure in the mechanism will cause the oil to spurt out in a stream. The flow of oil will stop when the oil index recedes below the surface of the cylinder head.

(3) Place the thermometer in the reserve oil drained from the mechanism and make a record of the temperature. Keep the thermometer out of the sun. This should represent as accurately as possible the temperature inside the recoil mechanism.

(4) Remove the counterrecoil cylinder front head and attach the recoil piston screw jack (C7336). By means of the jack move the piston rod approximately 10.2 cm (4 inches) to the rear, permitting the oil to escape through the oil release. Disconnect the gun from the recoil mechanism by removing the nuts from the recoil and counterrecoil rods.

(5) Assemble the adaptor (B105455) in the filling and drain hole of the recuperator cylinder. Attach the pressure gage (C6385) to the end of the adapter, leaving this connection slightly loose for "purging." Assemble the connection (A141612) to the pressure gage and the oil pump to the connection. Pump slowly to "purge" the line and tighten all connections.

(6) *Measuring friction of recoil rod stuffing box, counterrecoil piston, and counterrecoil rod stuffing box.*—Back out the jack screw. Slowly move both rods by forcing oil into the cylinders. While both rods are in motion and when the counterrecoil piston is between 3 and 4 inches from its forward position, take the gage reading. While taking the reading, tap the gage lightly to overcome the effect of friction in the gage itself. This reading represents the combined friction of the recoil rod stuffing box, counterrecoil piston and counterrecoil rod stuffing box. (Make a note of the reading.) Obtain three uniform gage readings.

NOTE.—Exercise the counterrecoil rod a sufficient number of times to insure that the last three gage readings are practically uniform. This is important since true friction readings cannot be obtained until the packings are well lubricated. The normal pressure necessary to overcome the combined friction is 184.6 psi. The friction should never be below 142 psi nor above 355 psi.

(7) Continue to pump slowly until the rods are in battery position and the oil index stops moving (5 mm beyond the face of the head), then take the gage reading. This reading represents the nitrogen pressure plus the floating piston friction ($AP+F$). (Make a note of the reading.)

(8) Loosen the pump connection sufficiently to allow the oil to escape by drops. Observe the gage hand as the pressure drops and record the reading when the hand becomes stationary. This reading

represents the nitrogen pressure minus the floating piston friction ($AP-F$). Repeat the measurements to check results.

d. To calculate nitrogen pressure.—(1) The nitrogen pressure in the mechanism is one-half the sum of the readings obtained in $c(7)$ and (8) above. Example:

Gage reading as found in (7)----	133.5 kg per sq cm	
	1895.7 psi	
Gage reading as found in (8)----	120.5 kg per sq cm	
	1711.1 psi	
Add these readings together-----	254.0 kg per sq cm	
	3606.8 psi	
Then divide the answer by 2-----	127.0 kg per sq cm	
	1803.4 psi	

(2) The correct pressure at any temperature may be found by referring to the temperatures and pressures in table I. It will be noted that for each 5° F. change in temperature there is a corresponding change of 1.03 kg per sq cm (14.62 psi). The recoil mechanism is considered serviceable with a variation of plus or minus 6 kg per sq cm (85.2 psi). If not within the limits, the recoil mechanism should go to a base shop.

TABLE I

Temperature (Degrees F)	Pressure (Kg/sq cm psi)		Temperature (Degrees F)	Pressure (Kg/sq cm psi)	
50	105	1492	105	116	1652
55	106	1506	110	117	1667
60	107	1521	115	118	1682
65	108	1535	120	119	1696
70	109	1550	125	120	1711
75	110	1565	130	121	1726
80	111	1579	135	122	1740
85	112	1594	140	123	1755
90	113	1608	145	124	1769
95	114	1623	150	125	1784
100	115	1638	155	126	1799

e. To calculate friction of the floating piston.—The friction of the floating piston is one-half the difference between the readings obtained in $c(7)$ and (8) above.

$$F=\frac{(AP+F)-(AP-F)}{2}$$

The normal value of F is 85.2 psi. The value of F should not be below 71 psi nor above 355 psi.

NOTE.—Packings which have been assembled for a considerable period of time may have high frictions. This is due to absorption of oil by the rubber packings. Example:

Gage reading as found in (7)------	133.5 kg per sq cm
Gage reading as found in (8)------	120.5 kg per sq cm
Subtract the low reading from the high reading----------	13.0 kg per sq cm
Then divide the answer by 2-------	6.5 kg per sq cm

f. Restoring recoil mechanism to normal.—(1) Remove the pump connection, allowing reserve oil to drain. Remove the adapter (B105455) and filling and drain valve release (A1001) and disassemble them. Assemble in place of the adapter (B105455) another adapter (B158805), and insert in the filling and drain plug hole.

(2) Attach the pump and after "purging" force oil into the cylinder until the oil index starts to move. Then apply 100 full strokes of the pump to force approximately 1 quart of oil into the mechanism. Remove all connections and assemble the filling and drain plug.

(3) When removing the jack screw, have the screw all the way back from the cylinder head to prevent the end of the screw from dropping against the cylinder wall.

(4) Assemble the adapter (B158805) with oil pump and connections to the drain hole in the replenisher and force in oil until the end of the piston is approximately 5¾ inches below the face of the replenisher. This constitutes the reserve for the recoil cylinder. Remove all connections and assemble the drain plug.

7. Equilibrators.—Approximately every 6 months, the following inspection should be made.

a. To check the nitrogen pressure.—(1) Place the gun at 0° or 65° elevation. Remove the hexagon head plug on the air filling valve and assemble in its place the air filling tube (C69285) (fig. 5). Remove the plug gradually to allow the escape of any air which may have built up a pressure against the plug due to a faulty valve. In the event of a leaky valve, the equilibrator pressure must be discharged, the valve repaired or replaced, and the equilibrator recharged.

Caution: Be sure the valve opener (B128853) on the filling tube is retracted, the air release valve is closed, the tee cap (A130646) is

closed, and the pressure gage is attached, before assembling to the filling valve.

(2) Force the spring loaded air filling valve open by screwing the valve opener forward. The pressure in the equilibrator will now be indicated on the gage. The gage reading should coincide with the pressure applicable for the temperature and the position of gun specified in table II. It should be noted that the ultimate test indicating proper pressure is the way in which the mechanism actually functions as indicated by the relative forces on the elevating handwheel throughout the full range of elevation.

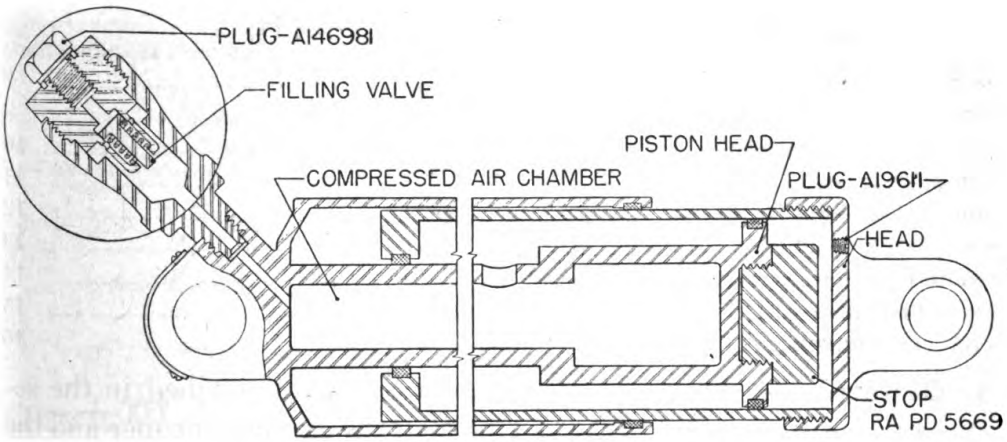


FIGURE 11.—Equilibrator.

TABLE II.—*Nitrogen pressure at different temperatures*

[Pressure lbs/sq in (gage)]

Temperature (degrees F.)	Gun at 0° elevation, equilibrator extended	Gun at 65° elevation, equilabrator closed
0	1308. 7	936. 8
10	1337. 5	957. 5
20	1366. 3	978. 2
30	1395. 1	998. 9
40	1423. 9	1019. 6
50	1452. 7	1040. 3
60	1481. 5	1061. 0
70	1510. 3	1081. 7
80	1539. 1	1102. 4
90	1567. 9	1123. 1
100	1596. 7	1143. 8
110	1625. 5	1164. 5

(3) If the pressure gage indicates a loss in pressure, soap suds should be applied to all thread connections of the equilibrator to discover possible leaks at the connections. If the connections are tight and the gage still indicates loss of pressure, the grease seals are not functioning properly, and the equilibrator should be returned to an arsenal or base shop for repair.

b. To relieve accumulated air in the head.—With the gun at zero degrees, remove the plug (A19611, fig. 11) from the rear head of the equilibrator; elevate to maximum elevation and replace the plug. Be sure the plug is tight.

SECTION III

MAINTENANCE AND REPAIR

8. General.—*a.* Maintenance instructions are described in the sequence of operations used in the assembly of the carriage proper and the assembly of the subassemblies.

b. Prior to assembly all parts to be assembled must be free from rust and dirt. Rough spots must be smoothed by use of a smooth file, emery cloth, or an oil stone. Burs and sharp edges must be removed. Metal parts in contact should be covered with oil, engine, SAE 10.

c. Cotter pins must be spread properly after assembly. Bolts, screws, and nuts must be tight and safeguarded properly with lockwashers or cotter pins. Screws drilled for locking wires must be wired securely.

d. To replace bushings, after removing the old bushing remove all burs which may exist in and around the hole. Fit the new bushing to enter a short distance into the hole. Lubricate the exterior of the bushing and, if possible, place a bolt with washers on both ends through the bushing and the hole and draw the bushing into place by means of the nut. If the bushing is in such a position that the above procedure cannot be followed, place a piece of hardwood against the bushing and drive it into place with a hammer. Ream the bushing to the desired fit after assembly.

9. Lubrication.—*a. General.*—Lubrication facilities must function properly and permit uninterrupted passage of lubricant. At assembly, the housings of antifriction bearings must be packed from one-half to two-thirds full with the proper lubricant. (See lubrication charts, figs. 12 and 13.) Lubrication fittings must be painted

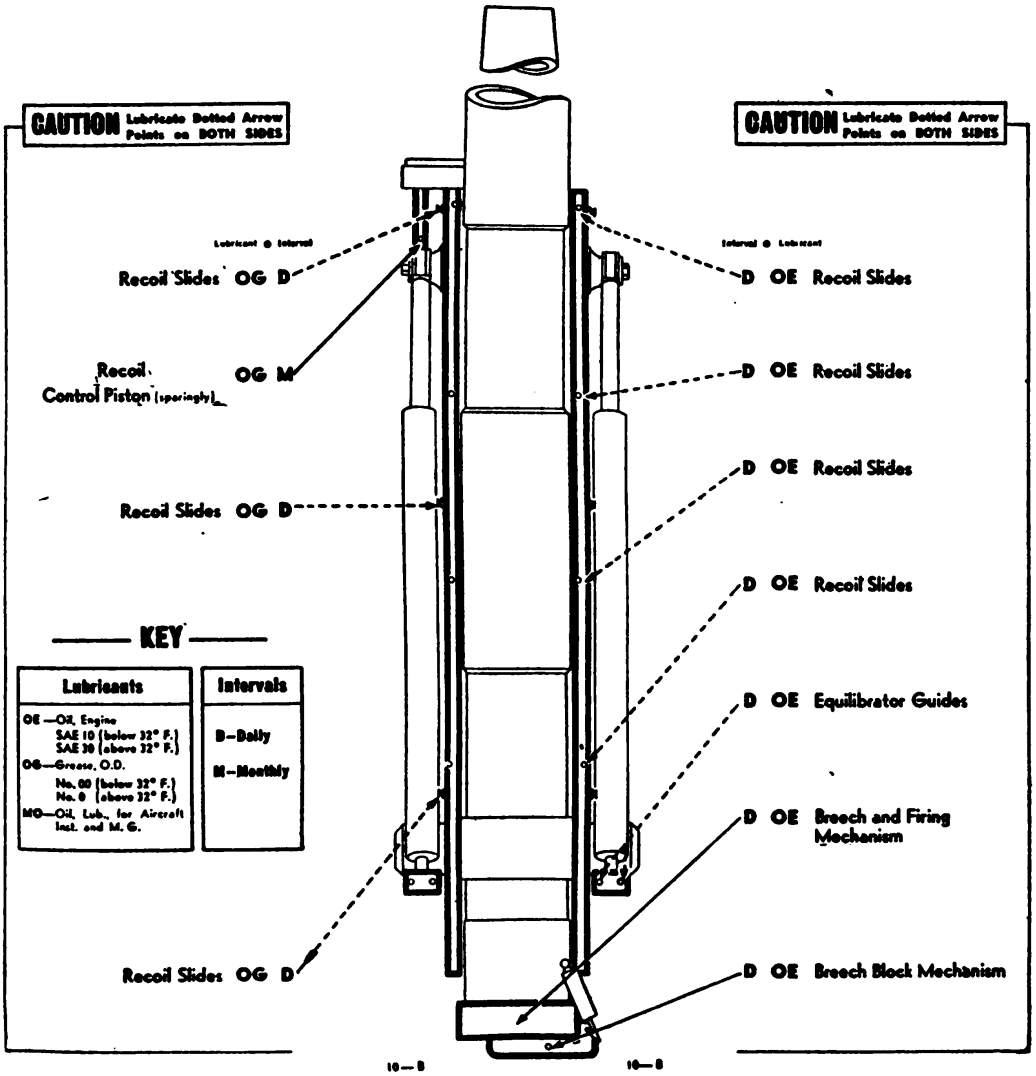
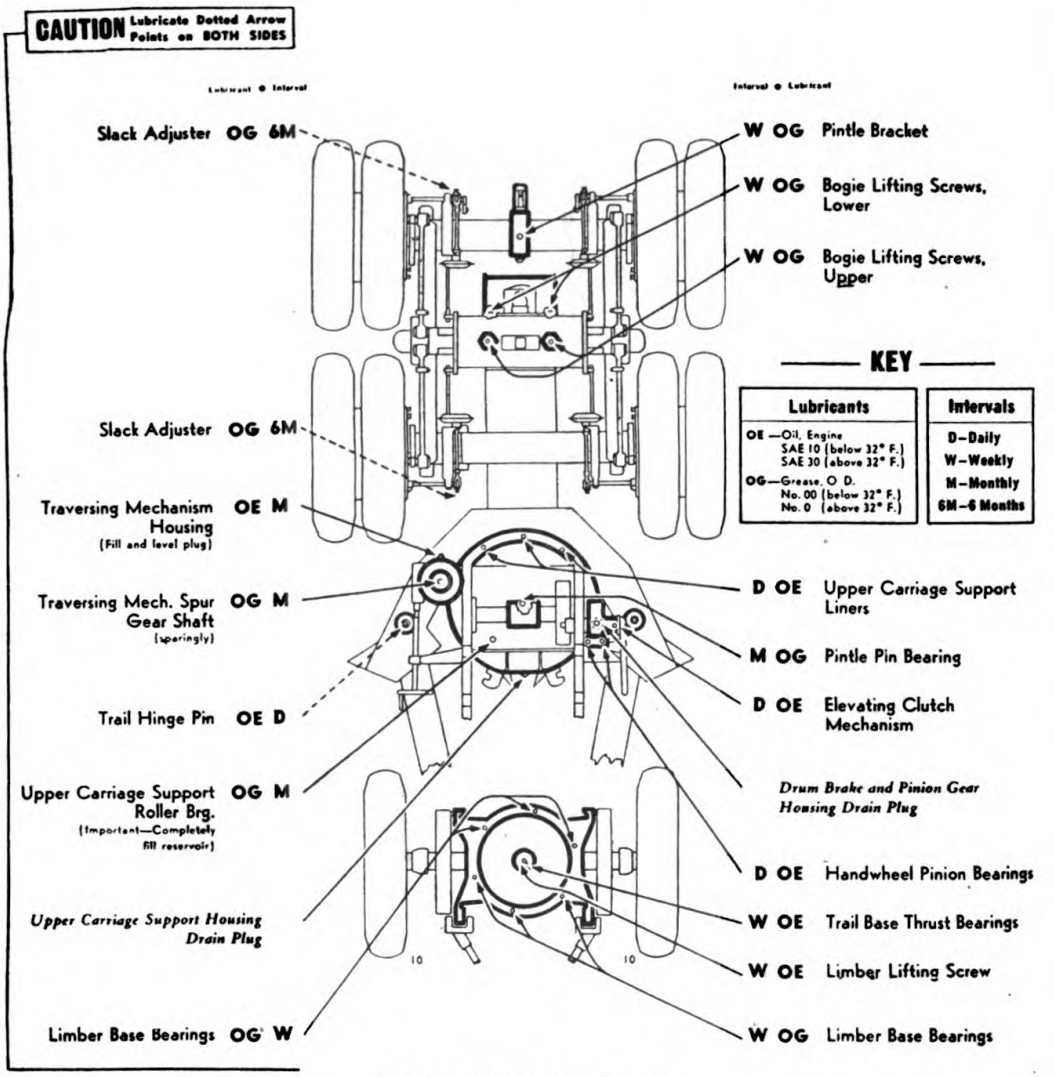


FIGURE 12.—Lubrication guide for 155-mm gun M1 and M1A1.

red so they may be readily located. When assembling oil retainers, check the assembly on the figure and place the sealing element of the retainer in the direction specified.

b. Lubrication at Arctic temperatures.—For operation at Arctic temperatures certain deviations from the lubrication charts must be made. For equipment subjected to sustained temperatures below

0° F., it will be necessary to use oil, lubricating, for aircraft instruments and machine guns, wherever oil, engine, SAE 10 or SAE 30, is specified as a lubricant in the lubrication chart. Under like conditions it will be necessary to relubricate the vehicle with grease, O. D., No. 00, in place of the grease, O. D., No. 0, specified in the



BOGIE CARRIAGE AND LIMBER

FIGURE 13.—Lubrication guide for bogie carriage and limber.

chart. It will be satisfactory to force in the prescribed grease with the equipment provided without any preliminary removal of old lubricant.

c. Points to be lubricated by ordnance maintenance personnel at time of ordnance inspection.—The following points are lubricated by ordnance maintenance personnel:

Bearings, cross beam trunnion.
Bearings, cradle trunnion.
Bearings, elevating spur gear shaft.
Bearings, brake gear shaft.
Bearings, traversing worm wheel shaft.
Bearings, bogie and limber wheel.
Bearings, brake camshaft.
Gears, drum brake and pinion gears.
Pins, brake anchor.
Yoke, clutch operating mechanism.

10. Assembling of carriage.—*a. Trails to bottom carriage.*—Assemble the trails to the bottom carriage by means of the trail pins (C73103) (figs. 16 and 17). Locate the trail pins on the pins (BFDX2CC) on the top and secure the assembly by the threaded plugs (B105026) on the bottom. Lock the plugs by means of screw (BCKX2CK) and see that the oil wells in the trail pins are fitted with clean waste saturated with lubricant.

b. Bogie to bottom carriage.—Move the bogie into position over the bottom carriage and assemble the pins (A19489) (fig. 19) in the holes provided in the front end of the bottom carriage.

c. Top carriage to bottom carriage.—Assemble the 13 heavy Belleville springs (B158581) (fig. 21) in the seats provided in the half circle facing the muzzle end of the gun. Assemble the 7 light Belleville springs (B158580) in the rear half circle. This method of assembly must be followed to compensate for the muzzle preponderance of the gun. Assemble the top carriage supporting roller bearing (C62336) (fig. 20) and the bottom carriage circular liner (C7186). Assemble the bushing (B105024). Place the top carriage in position on the bottom carriage and assemble the pintle (C7187). Assemble the roller bearing (A171739) and the pintle bolt (C68849). Secure the assembly by tightening the bolt from the bottom. Assemble the cotter pin and the pintle bolt cover (B158579) and the bottom carriage pintle bearing plug (B158125). Assemble the two bottom carriage liners (C73060 and C73061). Adjust the pintle bolt and nut to obtain the necessary .010-inch clearance between the top and bottom carriage.

d. Elevating mechanism to top carriage (see figs. 22 and 23).—Assemble bearings, rotating the bearings while clamping to insure that the bearings seat properly against cone rib. Heat the bearings in oil at about 305° F. for 1¼ hours to facilitate assembly. Fill bearing chamber ⅔ full with grease, O. D., No. 0. Assemble the roller bearing (B104910) on the left-hand end of the elevating gear shaft (C7142). Place the elevating gear cover assembly (C73312) and elevating gear (C7143) in position and insert the shaft from the left side. Assemble the gear on the three keys on the

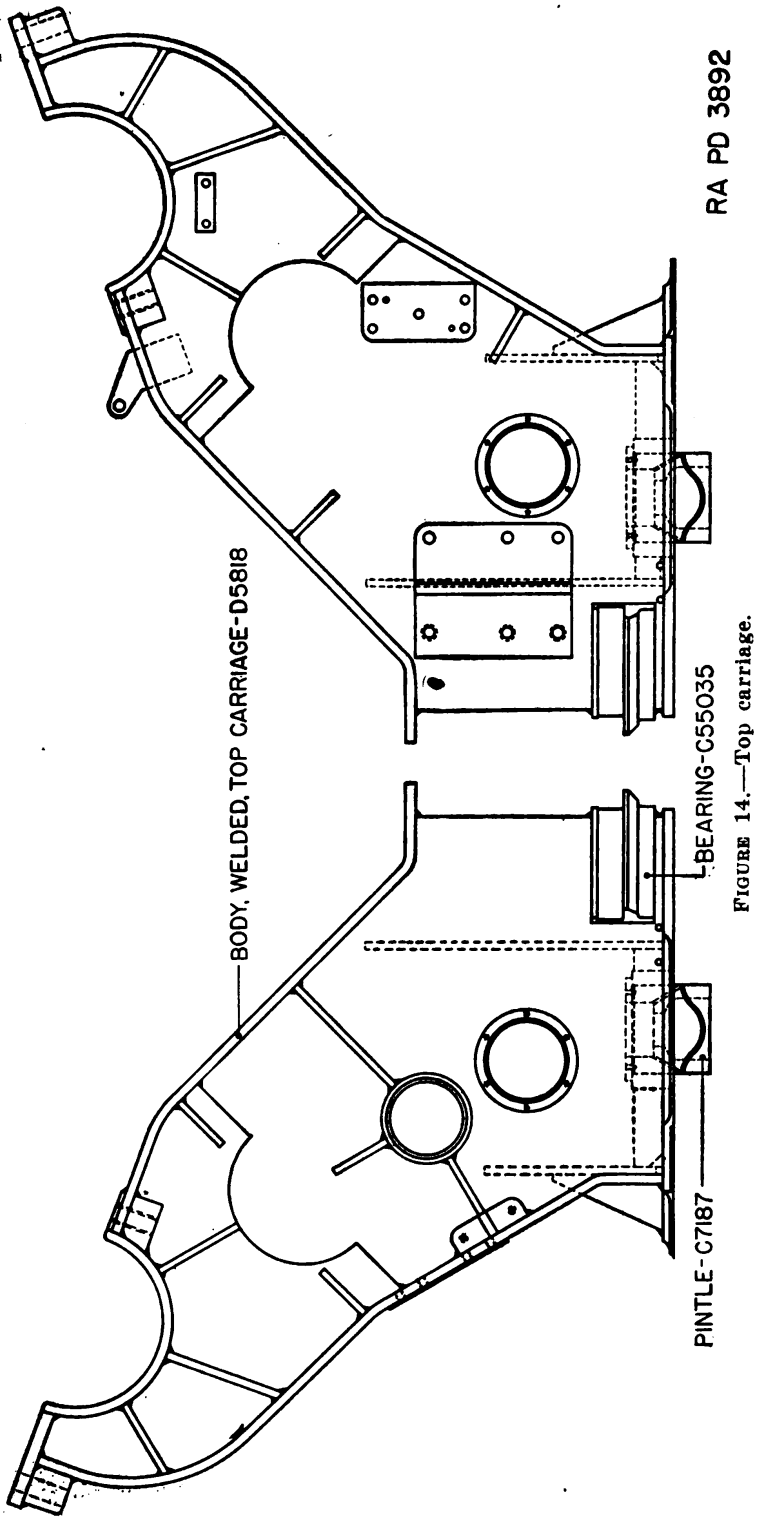


FIGURE 14.—Top carriage.

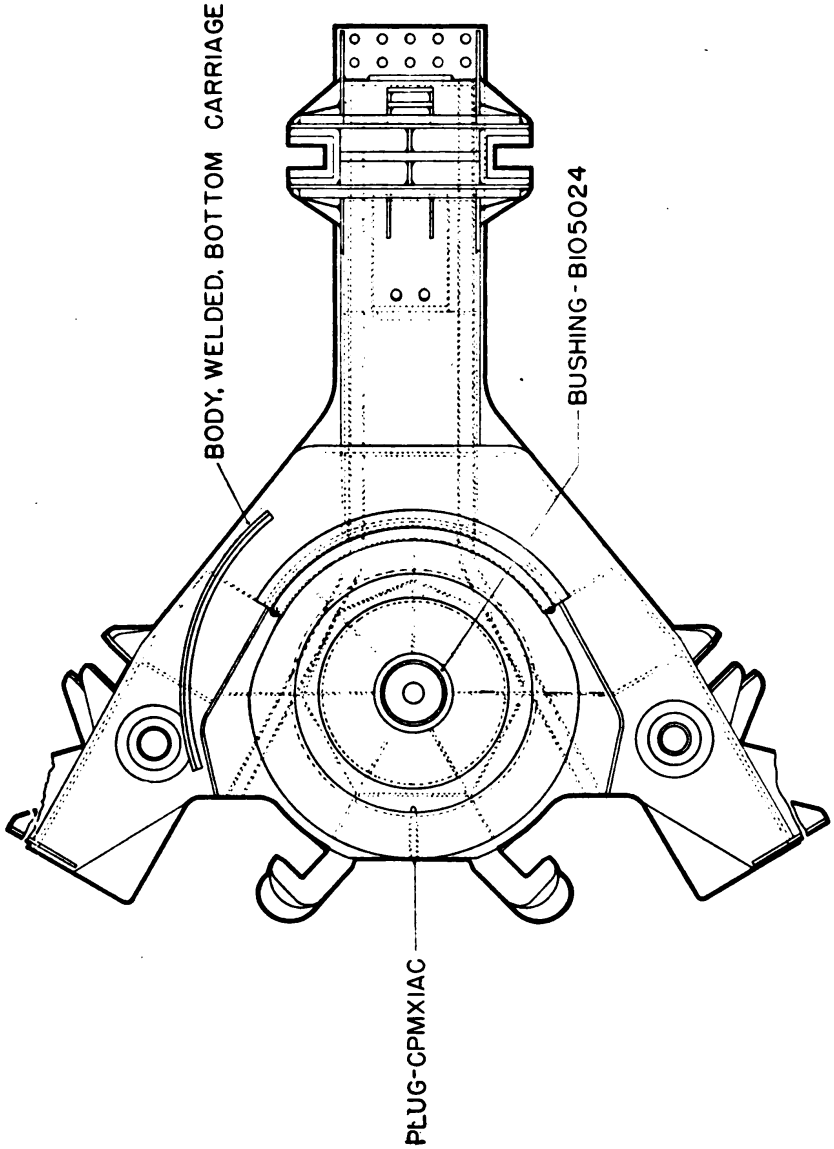


FIGURE 15.—Bottom carriage.

shaft, and the roller bearing (B104910) on the right end of the shaft. Assemble the nuts (BBRX1AS) and the elevating gear shaft housing caps (B104914). Assemble the elevating mechanism assembly to the top carriage and secure the cover (C73312).

NOTE.—The gear puller (C74750) is provided for disassembly of the shaft (C7142) in the event of possible replacement of shaft, gear, or roller bearings. In this case the cover is released, caps and nuts removed, and the shaft pushed to the left until the pinion contacts the left roller bearing. The gear puller is then attached in the threaded holes in the web of the gear and force is applied on the gear puller screw contacting the right end of the shaft. The gear and the right roller bearing can thereby be removed from the shaft.

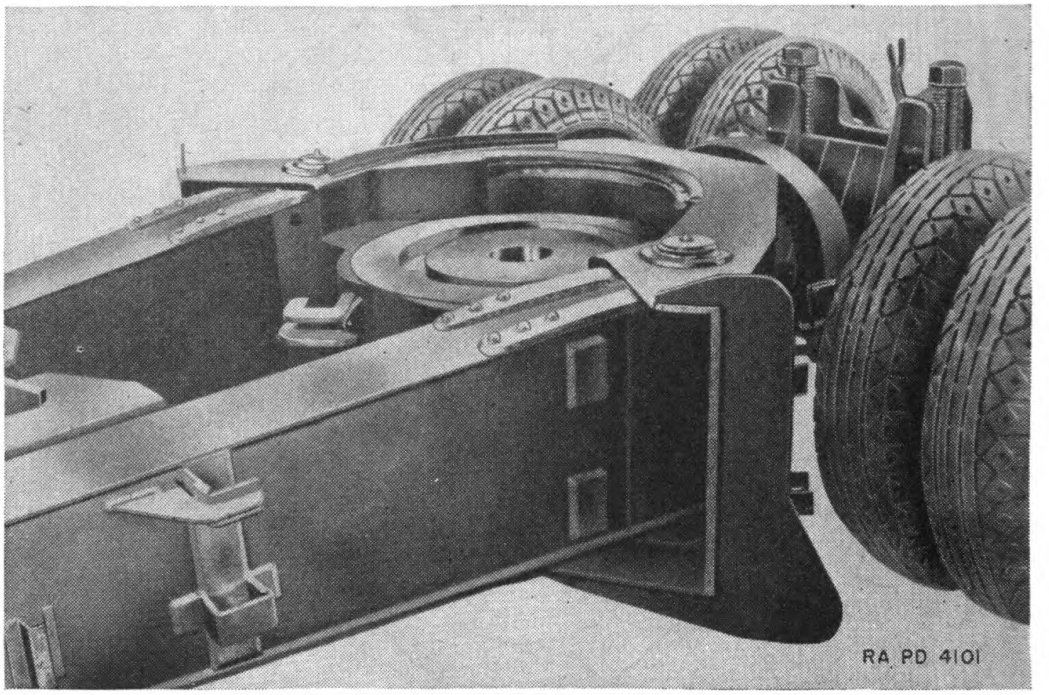


FIGURE 16.—Bottom carriage pintle.

e. Traversing mechanism to top carriage (see figs. 24 and 25).—Assemble the housing (D5734) to the top carriage and attach the flexible joint (A19909) to the worm (C7205). Assemble the handwheel bracket to the top carriage and the handwheel shaft to the flexible joint.

f. Cradle to top carriage (see figs. 26 to 29, incl.).—Assemble the roller bearings (B105092) in the right and left caps (D5788 and D5782), respectively, and place the roller bearings on the cradle trunnions. Secure the bearings by inserting the taper sleeves (B105094) and fastening the nuts (B105093) with the washer (B105091). Assemble the right and left caps (B105202 and B105201), respectively. Note the space provided for the expansion

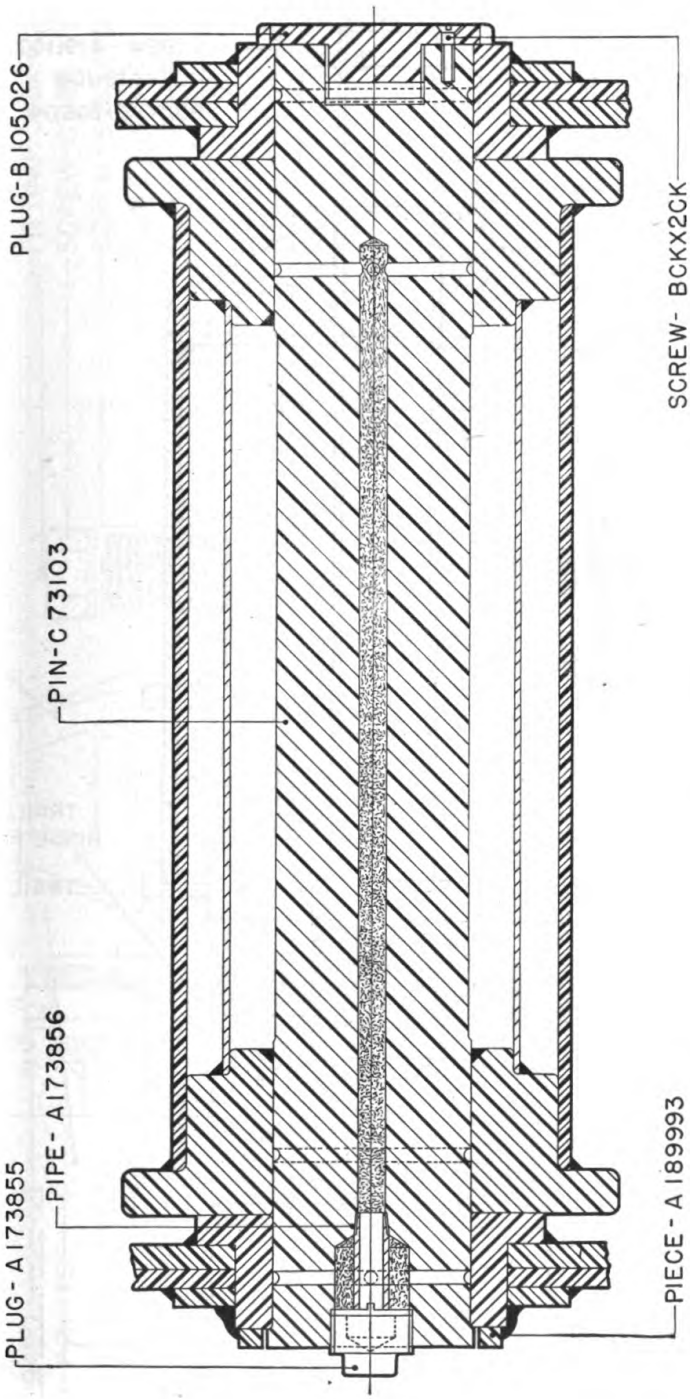


FIGURE 17.—Trail hinge pin.

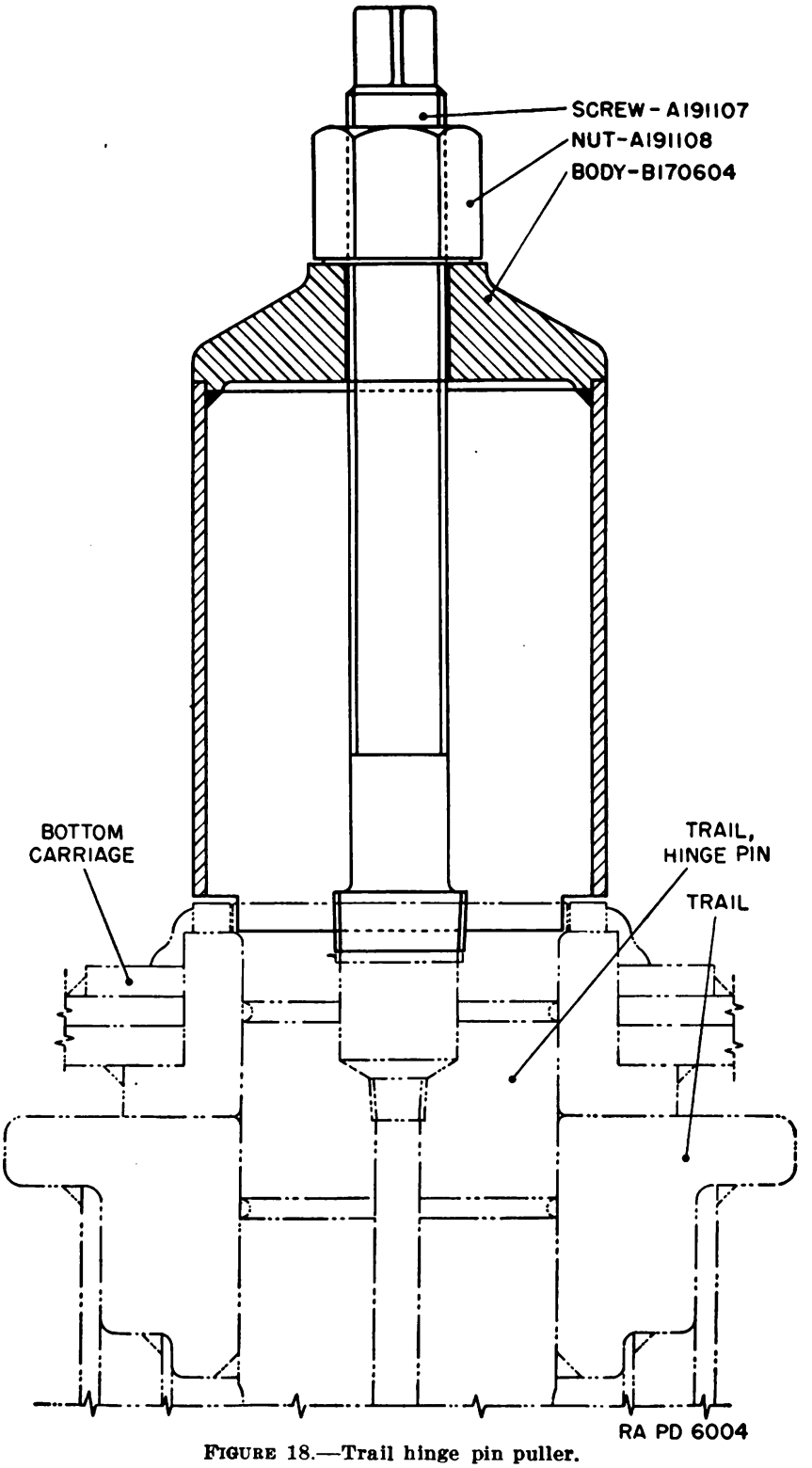


FIGURE 18.—Trail hinge pin puller.

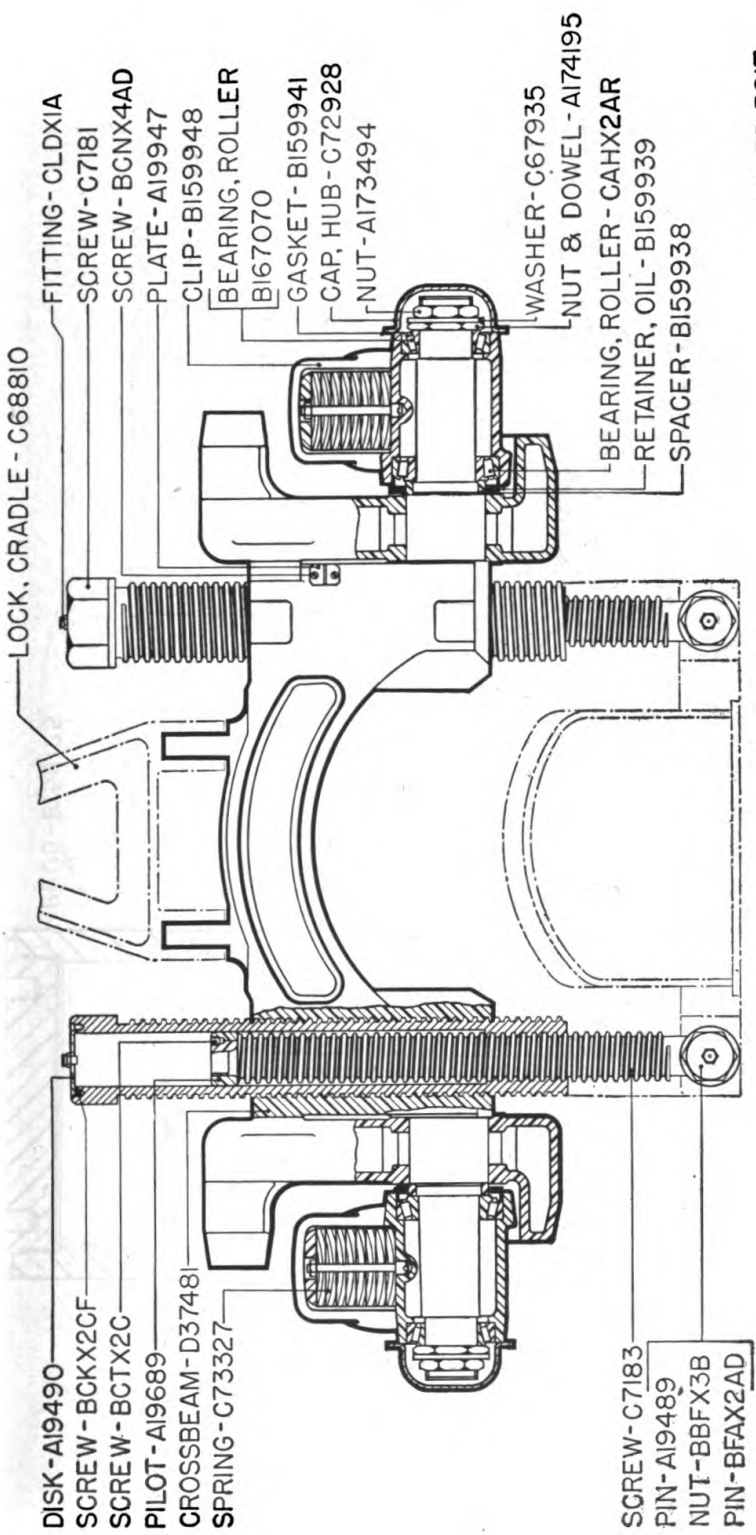


FIGURE 19.—Bogie lifting mechanism.

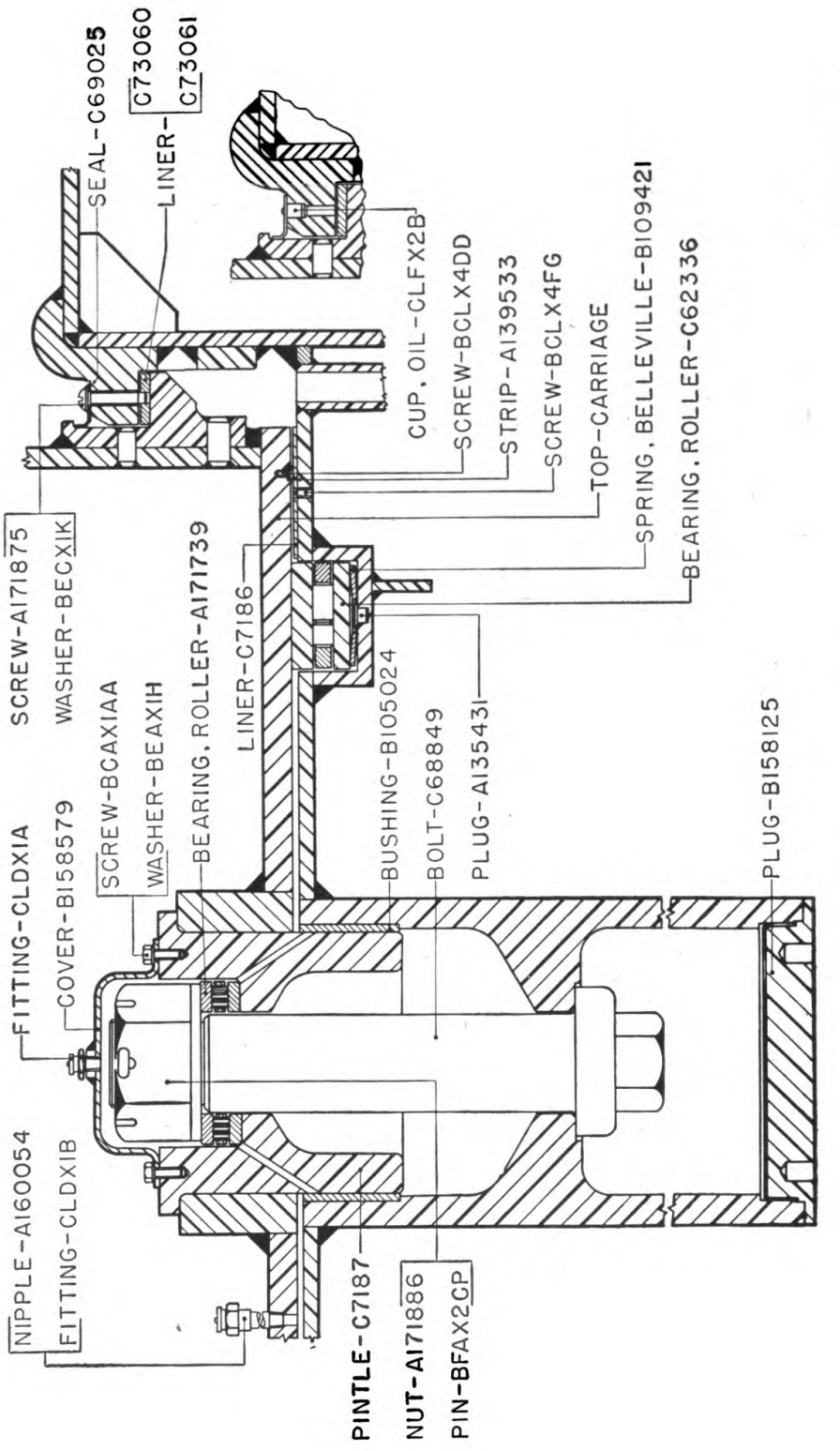


FIGURE 20.—Pintle bearing.

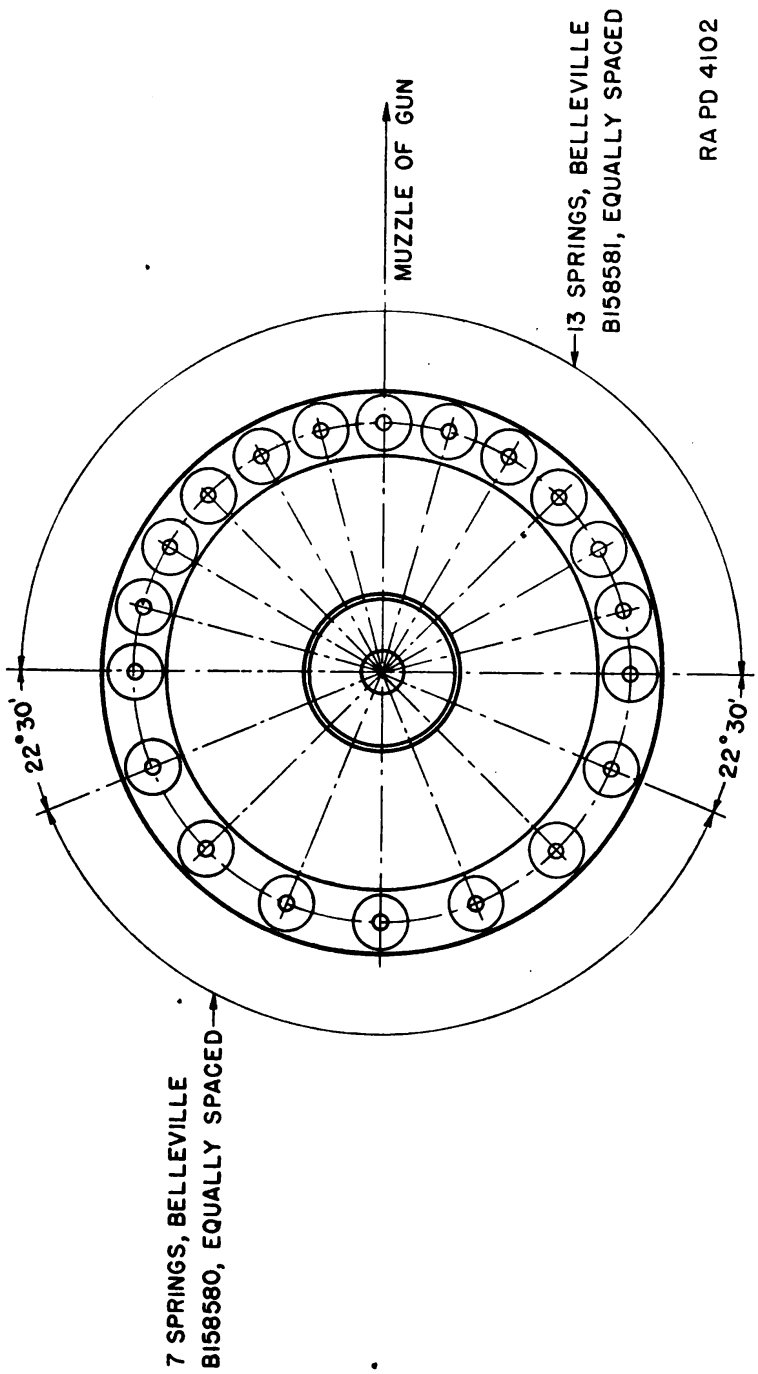


FIGURE 21.—Location of Belleville springs in bottom carriage.

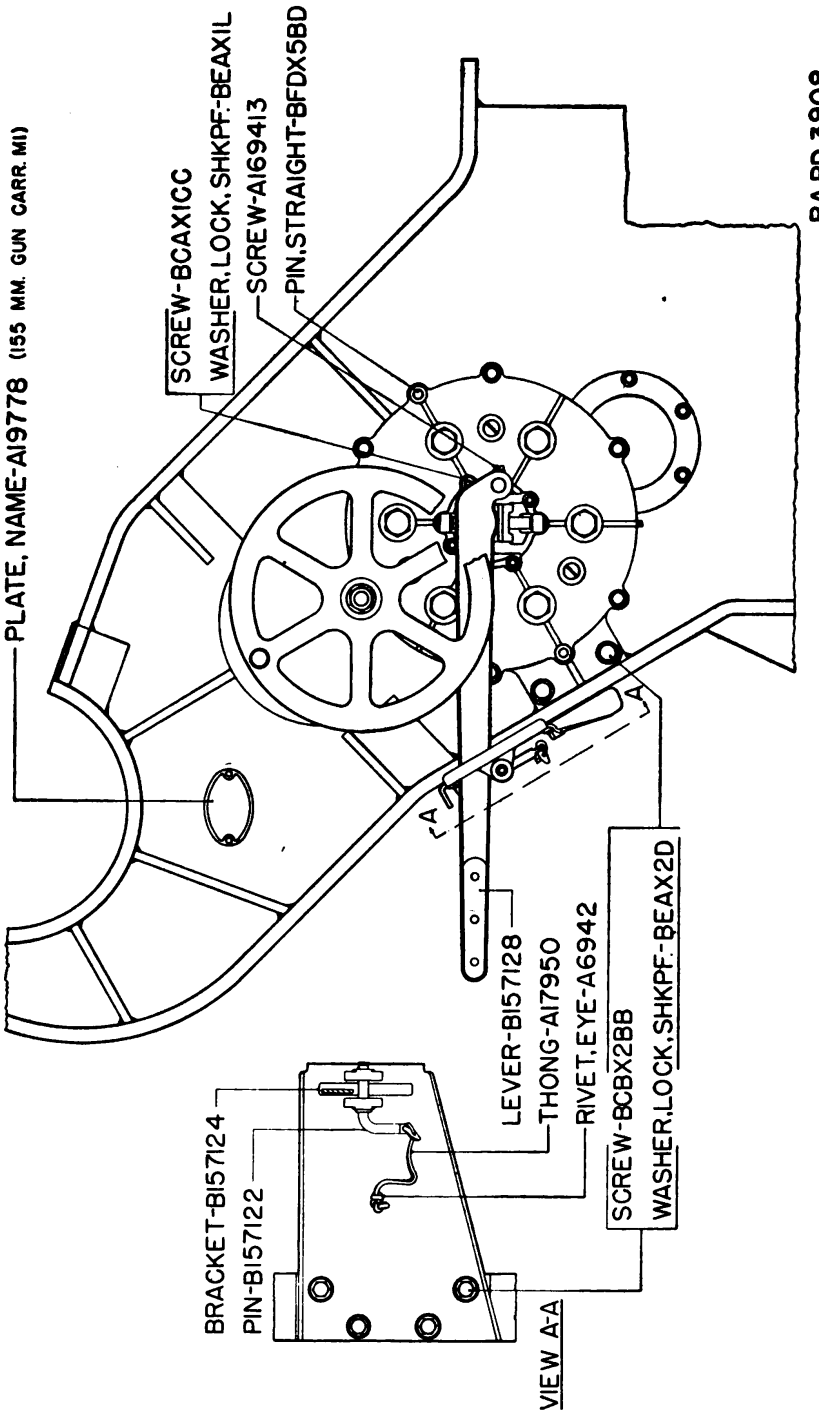


FIGURE 22.—Elevating mechanism.

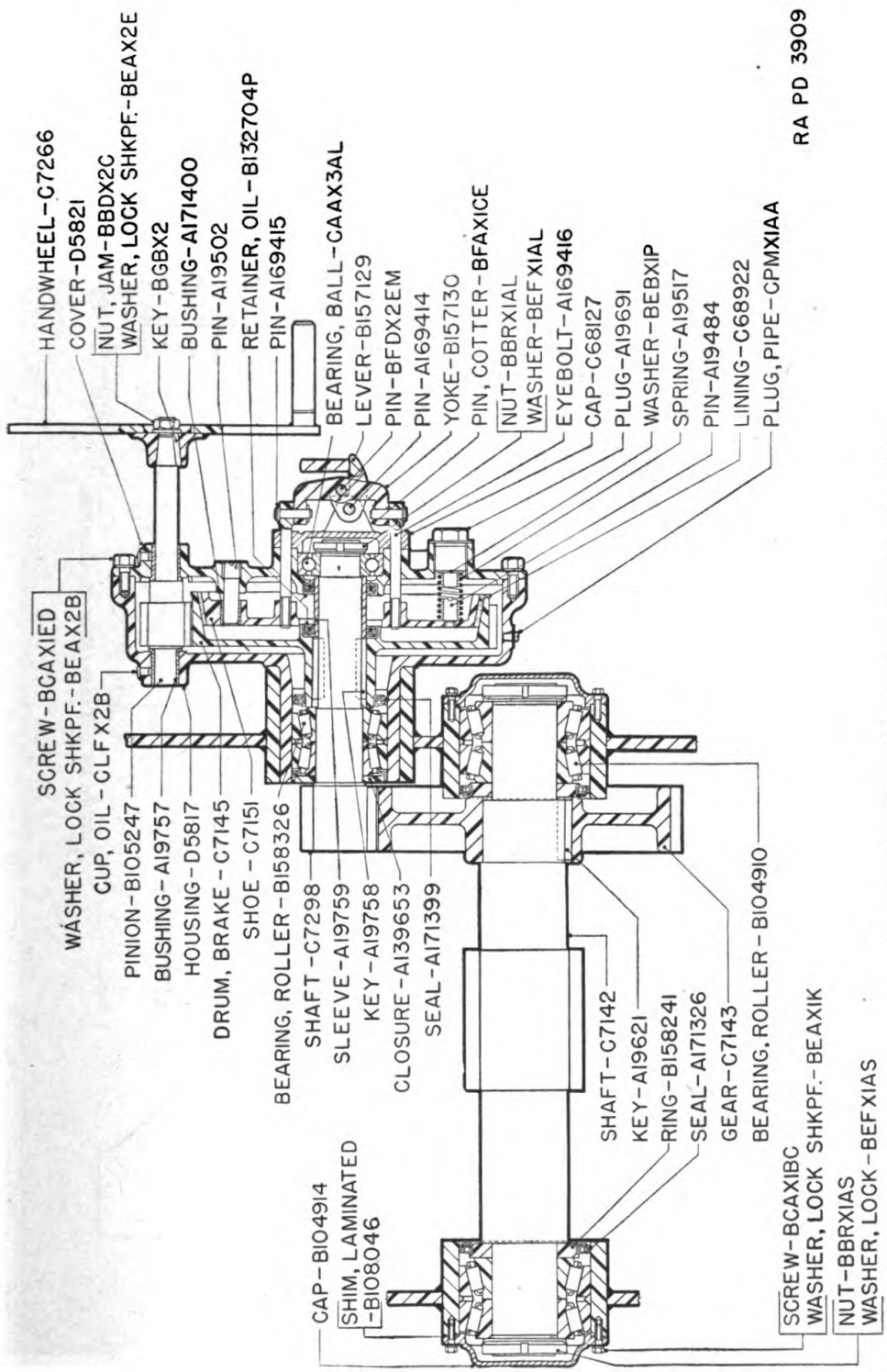


FIGURE 23.—Elevating mechanism—section view.

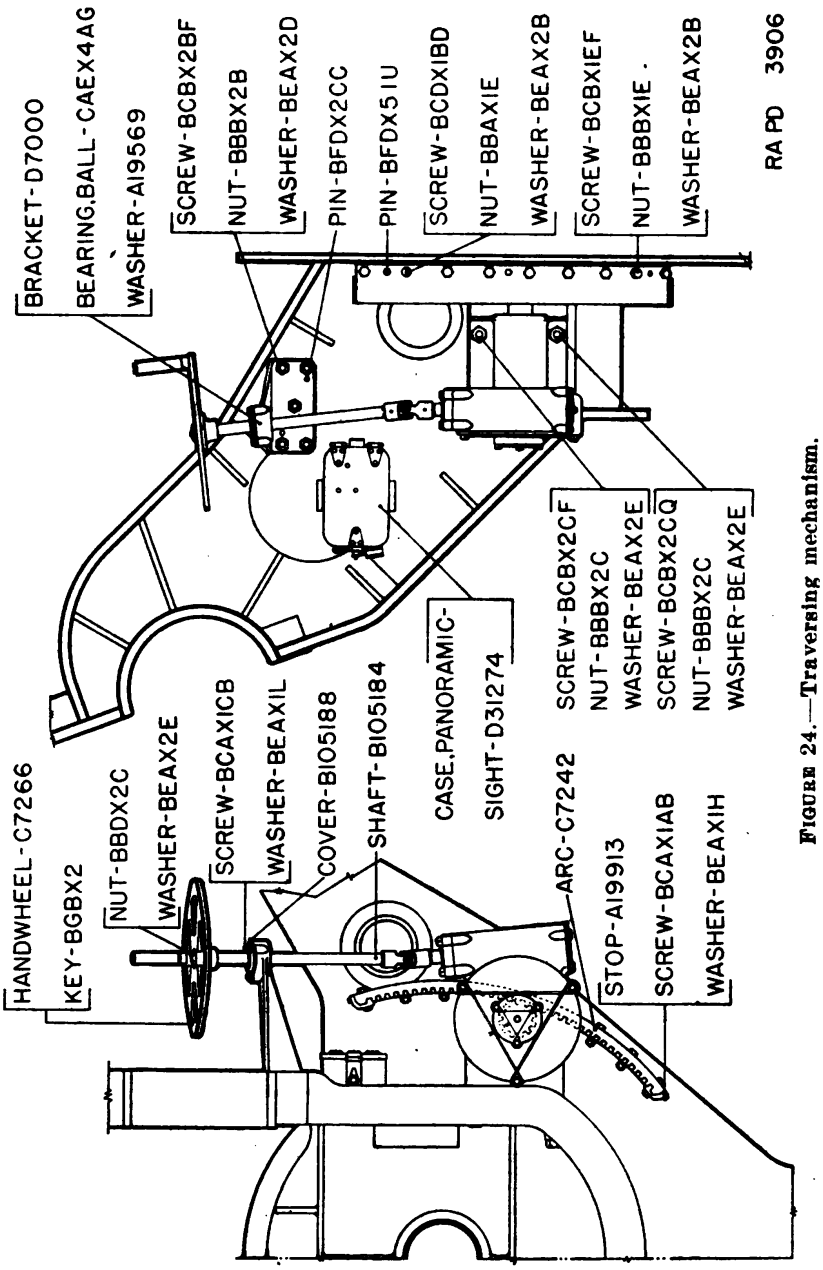


FIGURE 24.—Traversing mechanism.

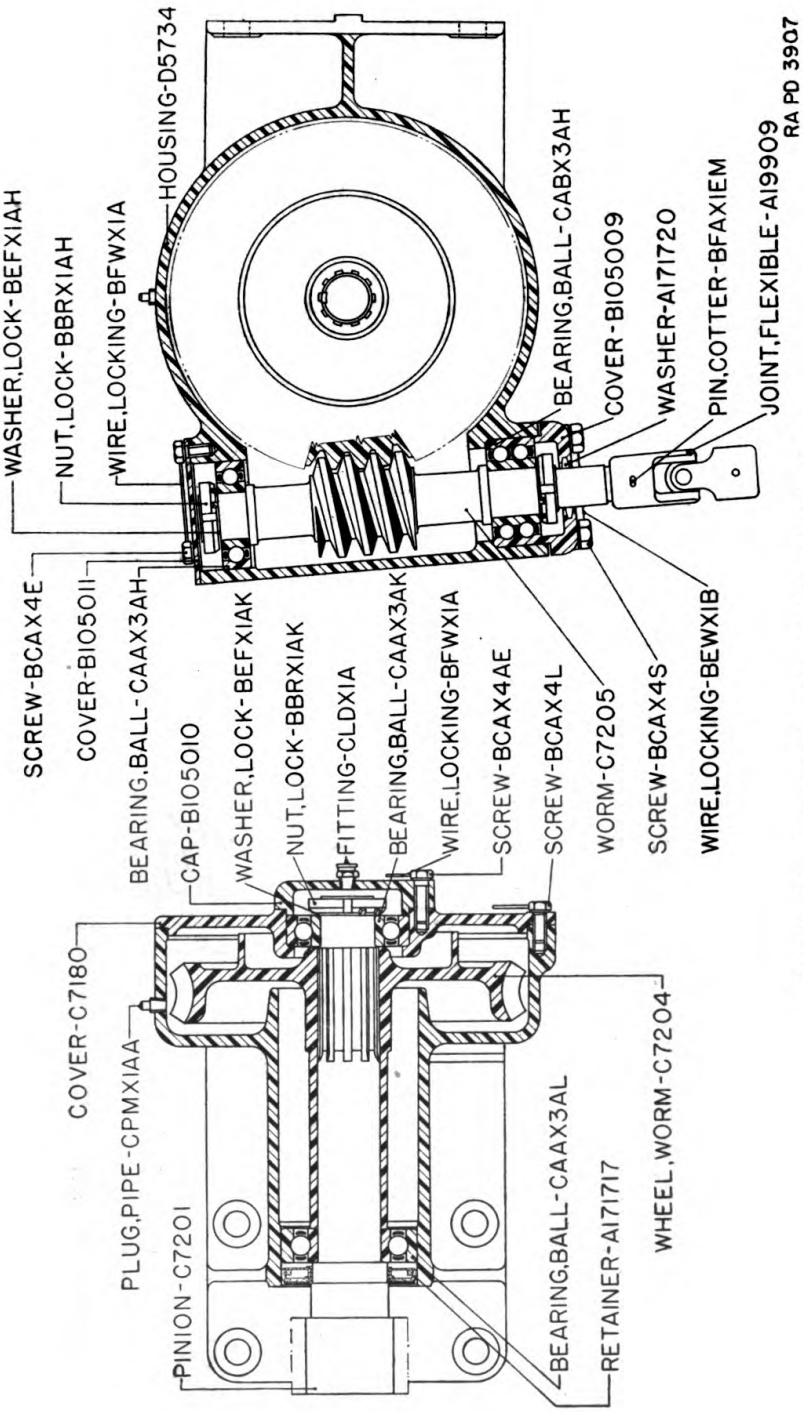


FIGURE 25.—Traversing mechanism—section view.

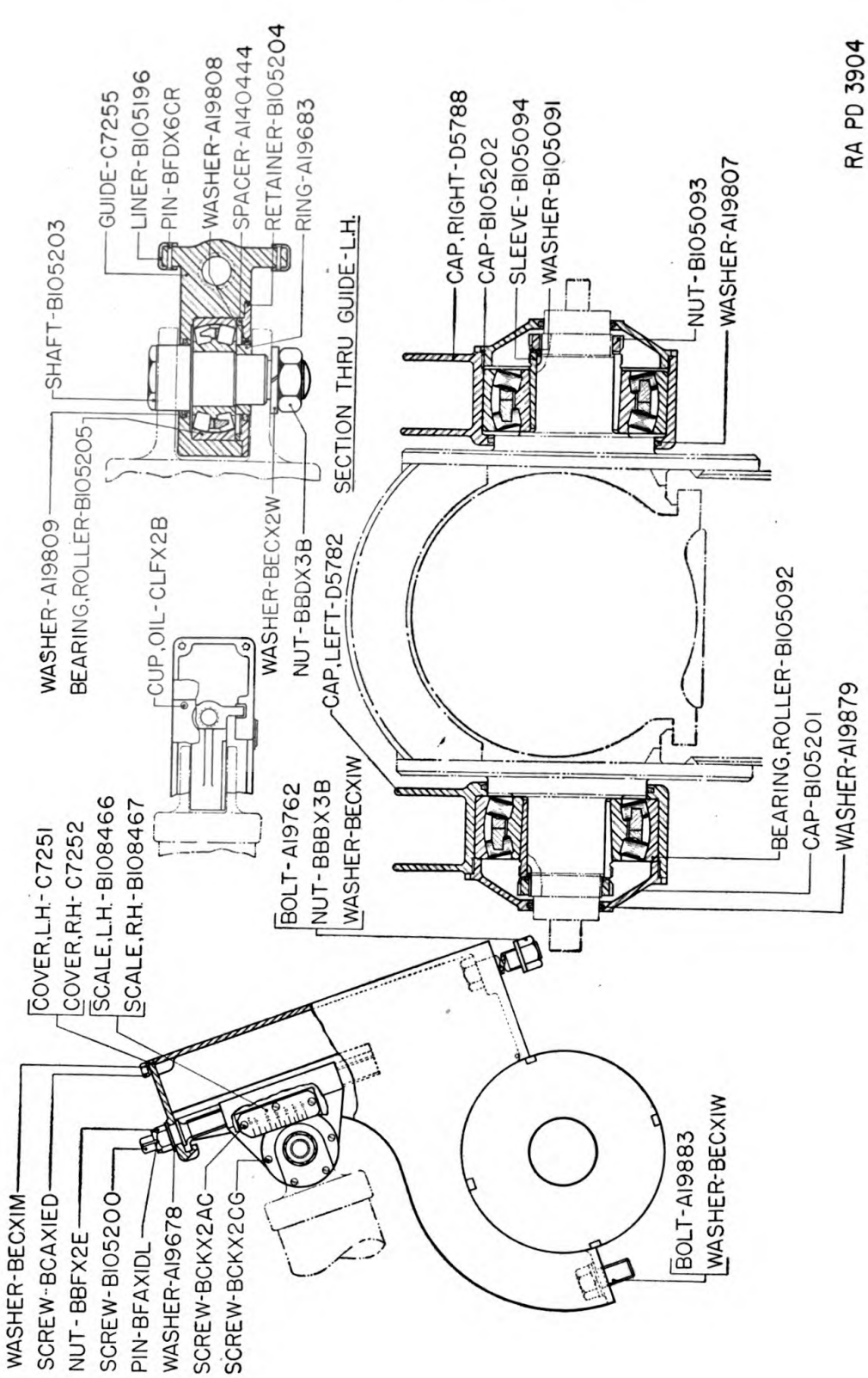


FIGURE 26.—Trunnion bearing.

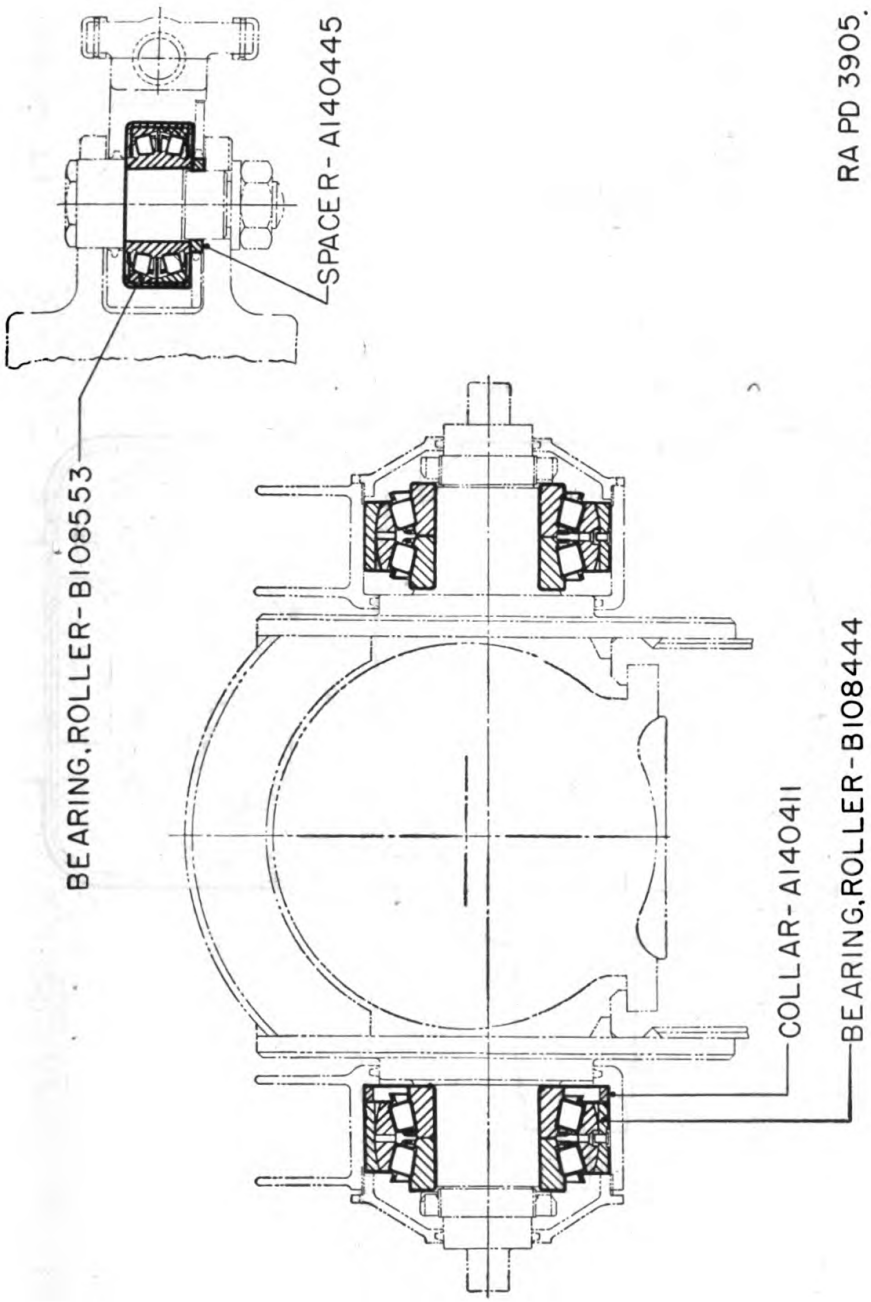


FIGURE 27.—Trunnion bearing—alternate design.

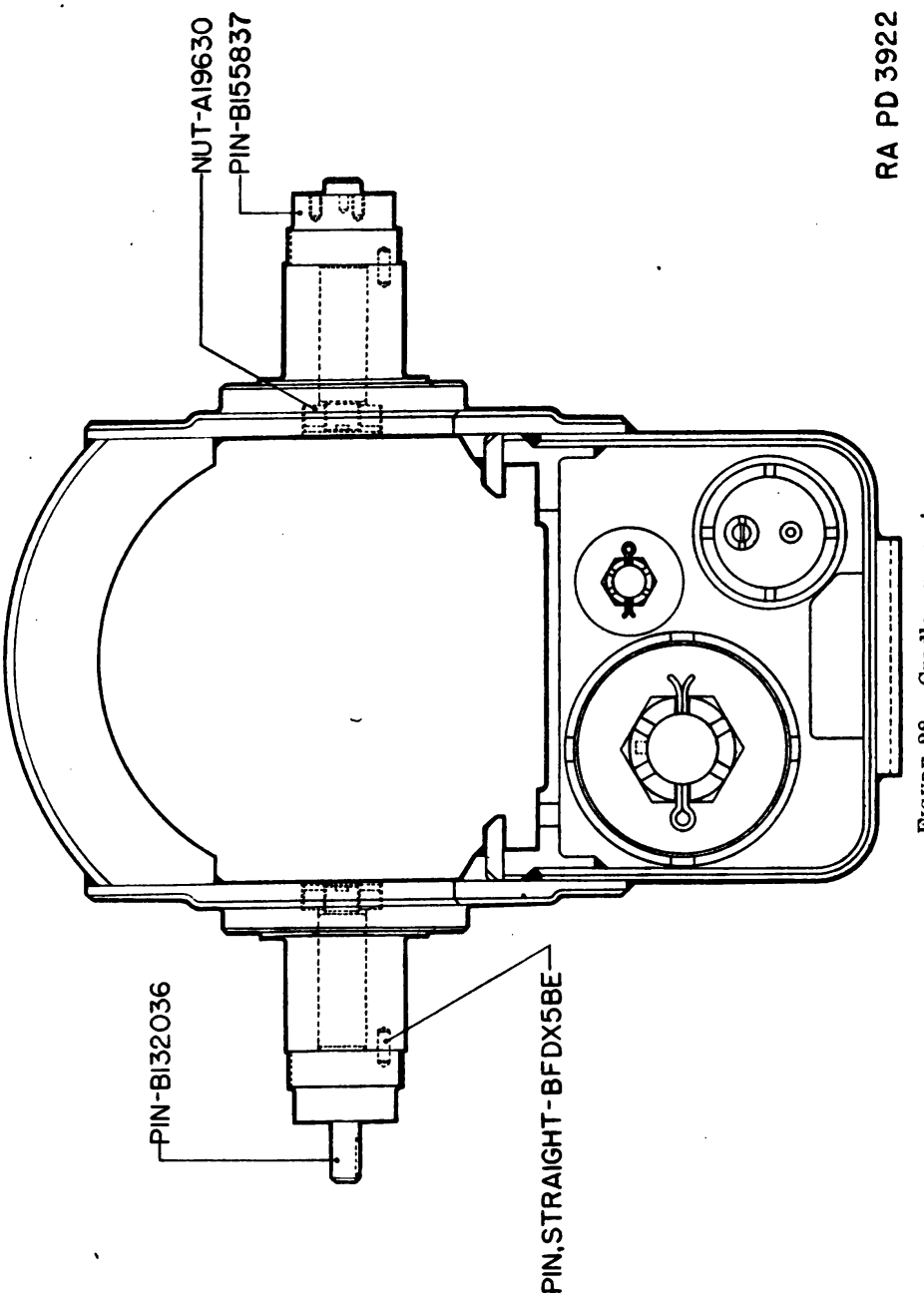


FIGURE 28.—Cradle—rear view.

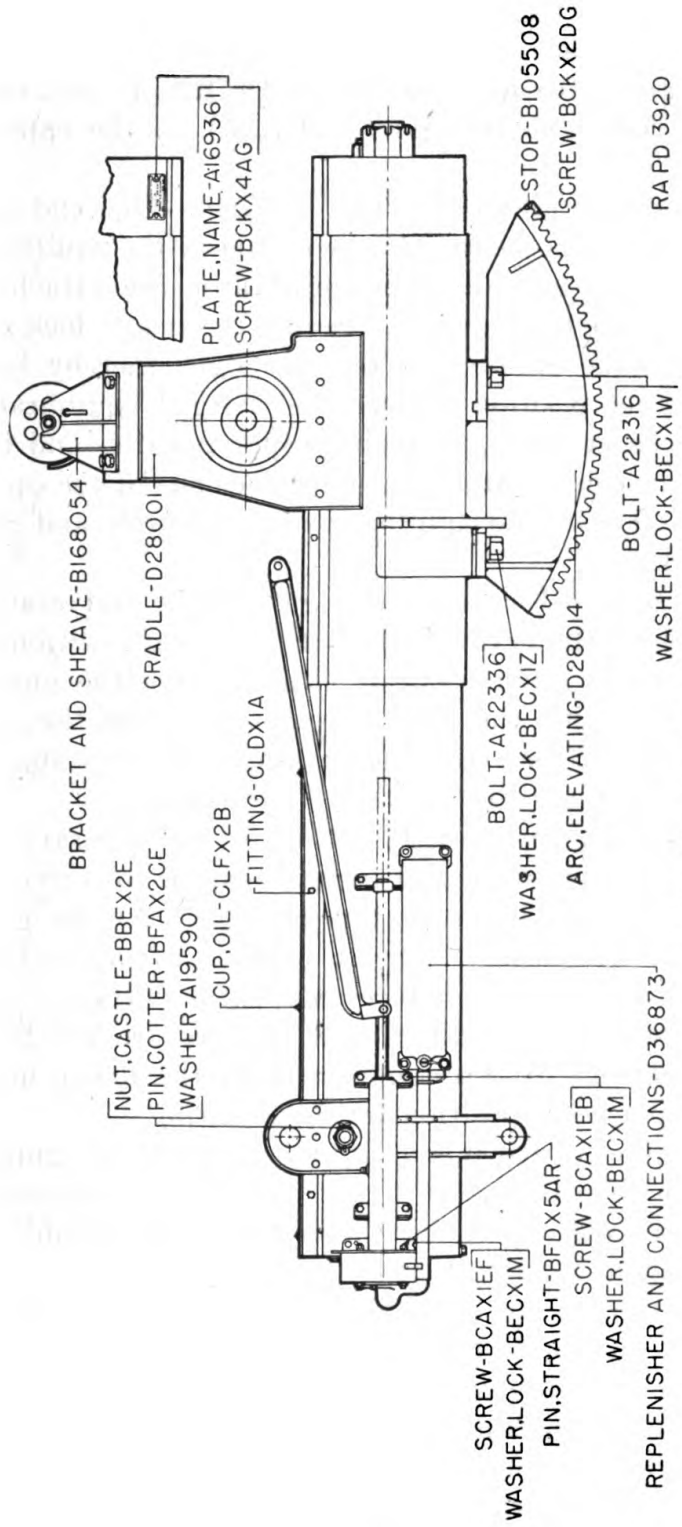


FIGURE 29.—Cradle—side view.

between the inner end of the cap (B105202) and the outer face of the roller bearing on the right-hand trunnion. Assemble the cradle (with the elevating arc bolted to the underside of the cradle) and bolt the right and left caps (D5788 and D5782), respectively, to the top carriage. Assemble the guides (C7255) to the caps (figs. 26 and 27).

g. Equilibrators to cradle and top carriage.—One end of each of the two equilibrators is secured to the cradle at the equilibrator connection. The other ends of the equilibrator are attached to the trunnion caps on the top carriage. Secure the cradle lock connection on the cradle to the cradle lock on the bogie, thereby locking the cradle in traveling position. Place the charged equilibrators, with equilibrator locks attached, in their proper position and adjust the cap screws on the equilibrator locks until the ends of the equilibrators can be secured. Fasten the equilibrator pins securely and remove the equilibrator locks.

h. Gun to cradle.—Lubricate the gun slides and cradle guides thoroughly. With the cradle locked in traveling position, slide the gun into the cradle guides, taking care to have the gun slides in proper alinement with the cradle guides. Secure the recoil and counterrecoil rods of the recoil mechanism to the gun lug by means of the recoil rod nut and the counterrecoil rod nut.

11. Dismounting gun.—*a.* It will rarely be necessary to remove the gun, recoil mechanism or top carriage except to correct malfunction of the recoil mechanism or top carriage. As the gun weighs over 4½ tons it will be necessary to provide lifting jacks, suitable wood blocking, and timbers before such dismounting is attempted. When the above jacks, blocking, and timbers are available, select a space large enough to allow movement of the prime mover after the carriage is placed in position for dismounting.

b. Place the gun in battery and unlimber as for changing to firing position. Place the carriage in firing position, as outlined in paragraph 12, TM 9–350, except for the trails which should be spread until they are about parallel.

c. Elevate the gun to 0° elevation. Place suitable cribbing under the rear end of the cradle to take the strain off the elevating mechanism when the gun is drawn to the rear. Retract the gun into traveling position by means of the prime mover. Block as may be necessary and slide the gun out of the cradle, taking precautions not to cramp the gun in the cradle ways as it is being removed.

12. Dismounting equilibrators.—Assemble equilibrator locking pieces (C67962 and C67963) (fig. 30) on the body of extended

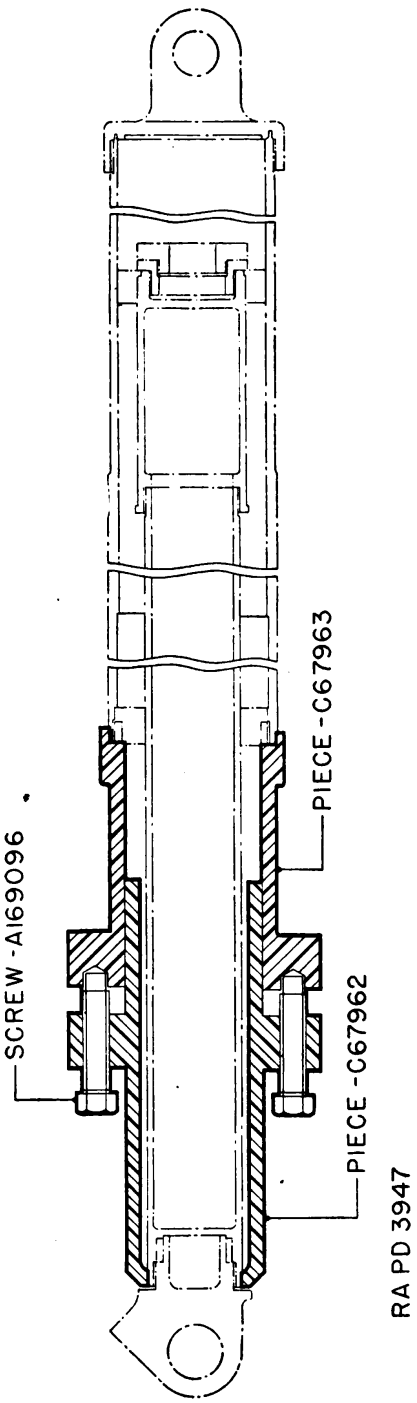


FIGURE 30.—Equilibrator lock.

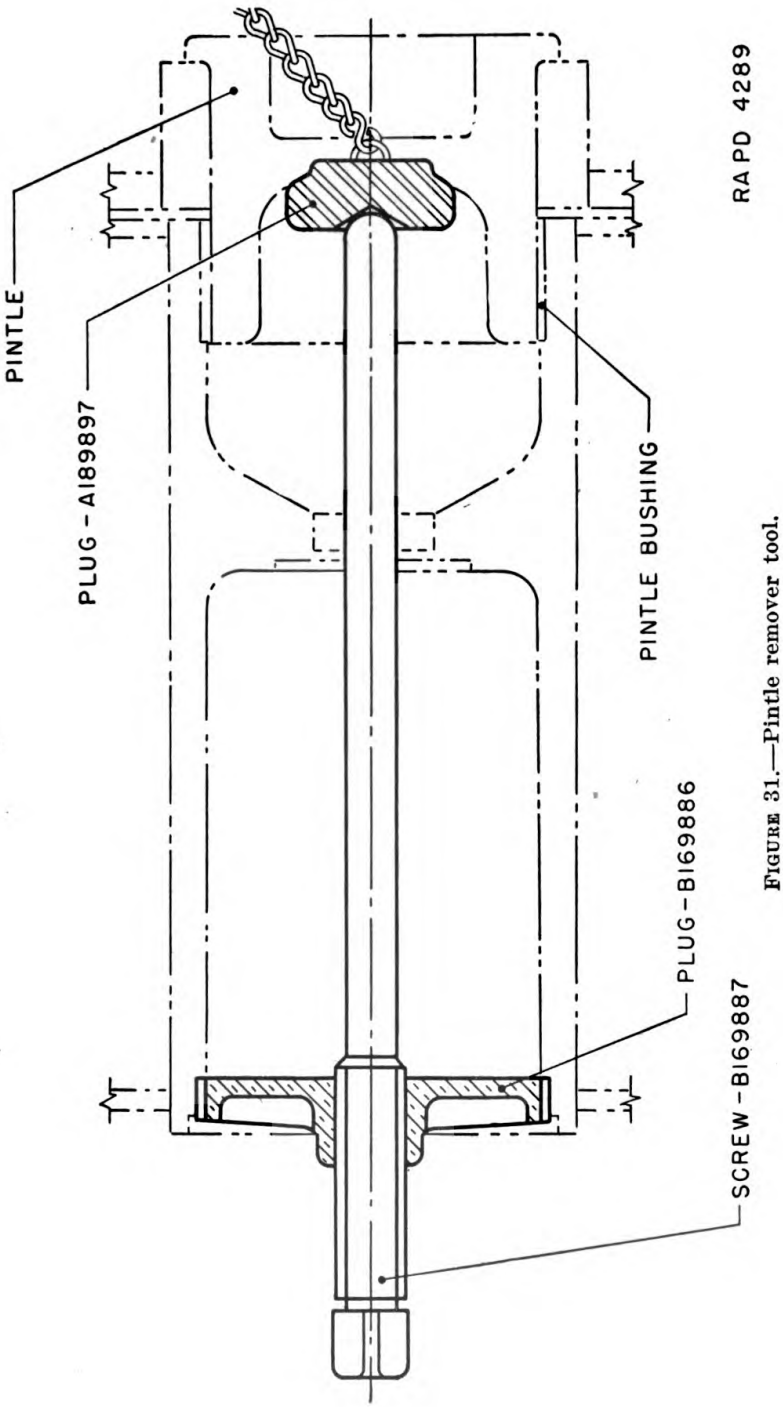


FIGURE 31.—Pintle remover tool.

plunger between the equilibrator valve head (C59232) and the case. Adjust the cap screws (A169096) until the tension of the equilibrators is absorbed and then remove the equilibrators. Disassembly of the equilibrator requires special facilities such as are available at base repair shops.

13. Dismounting cradle.—Erect a garrison gin or an improvised derrick capable of lifting 2 tons in such a position that it will be possible after removing the caps (B105202 and B105201) (figs. 26 and 27) and trunnion bearing caps (D5788 and D5782) to lift the cradle clear of its bearing in the top carriage and to lower it safely to the ground.

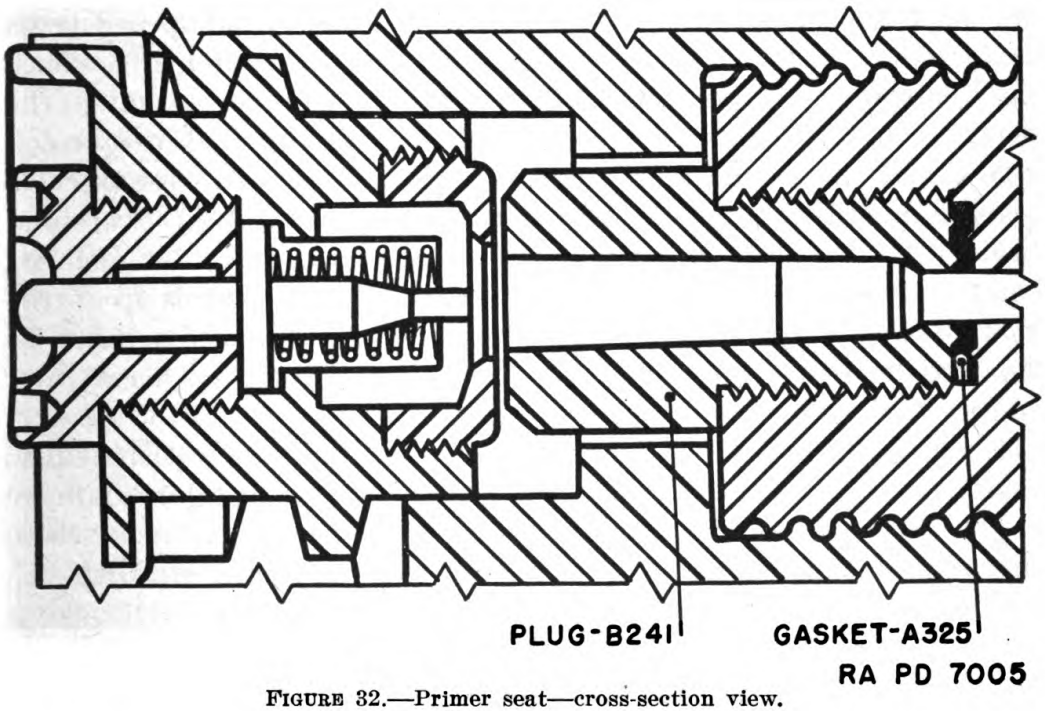


FIGURE 32.—Primer seat—cross-section view.

14. Dismounting top carriage.—*a.* If it becomes necessary to remove the top carriage, jack up the trails and bottom carriage until space is provided to remove the plug (B158125) (fig. 20).

Caution: Place cribbing under the bottom carriage and remove the jacks before attempting to crawl under the carriage.

b. Removal of the plug will expose the head of the pintle bolt (C68849). Remove the pintle bolt cover (B158579) and the nut (A171886). If the bolt turns when you try to unscrew the nut, place a wrench on the head of the bolt (C68849). Remove the two liners (C73060 and C73061). Attach the pintle remover tool (fig. 31) and raise the pintle (C7187) up through its socket until it is

stopped by the elevating arc pinion gear. Block the pintle in this position. Slide the top carriage carefully to the rear until the top carriage is free of the bottom carriage. Then place the garrison gin or the improvised derrick in position and lift the top carriage from the mount.

15. Breech mechanism.—*a. To remove seized breechblock.*—The breechblock may be seized by expansion of the obturator, or the seizing may be in the threads of the breechblock carrier or in the bearing surface of the crankshaft (C70426). Unscrew the firing mechanism. Place a solid piece of hardwood or a bar of soft copper against the face of the breechblock or breechblock carrier. Give it a sharp blow with a heavy hammer at the same time pulling down and back on the operating lever. If it still cannot be opened try a clean 4-inch by 4-inch timber through the bore as a rammer to shock the obturator. When the breech has been opened, examine the threads on the breechblock carrier as well as those of the breech recess and make necessary repairs. If the threads have become scarred or bruised, smooth them by filing and polishing. Scars and bruises on the pressure side of the threads can never be removed entirely, because of the danger of destroying the relation of the surfaces. The removal of metal by filing and polishing must be very sparing and just sufficient to remove the raised metal and restore the original contour of the threads.

b. Primer failures.—Many firing failures that are attributed to faulty primers may be caused by malfunction of the firing mechanism.

(1) *Dirty firing mechanism.*—Disassemble the mechanism, clean thoroughly with solvent, dry-cleaning, wipe dry and oil with oil, engine, SAE 10.

(2) *Incorrect adjustment of firing pin protrusion.*—Disassemble the firing mechanism and examine the firing pin. If broken or unduly blunted, replace it with a new pin. Assemble the mechanism and see that the firing pin protrdues $\frac{1}{32}$ of an inch when the firing pin guide is pressed down completely. Test adjustment of the firing mechanism by actually firing two service primers.

c. Eroded primer seat in the obturator spindle plug.—This condition causes a portion of the fired primer to burn out. In certain cases pieces of the primer remain in the primer seat after ejection of the primer and in extreme cases blow-out may occur. Unscrew and remove the used plug. To remove the spindle gasket use a counterbore having a body diameter slightly less than the inside diameter of the screw threads of the spindle and a tit with a running fit in the vent hole. Care should be taken not to remove stock

from the obturator spindle. Replace used spindle plug gasket with new gasket of the right thickness and replace used spindle plug with new plug. Screw the plug against the gasket, compressing it sufficiently to get the prescribed relation between the firing pin and the spindle. Then ream the vent hole in the gasket to size.

d. Bruised gas check pad seat.—Smooth by filing and polishing, using the same care as when correcting the same condition in the breech recess.

e. Eroded obturator spindle vent bushing.—Remove the eroded bushing by means of a drill or counterbore. Be sure not to destroy the threads in the obturator spindle. Insert a new bushing, screwing it in tightly. Finish it off flush with the spindle; drill and ream the vent hole from the rear end. It may be necessary to weld a drill of the proper size to a piece of drill rod to drill the vent hole properly in the obturator spindle vent bushing.

f. Damaged leveling plates.—Correct by filing or scraping in accordance with the following procedure:

(1) With the gun in an approximately horizontal position, place a parallel straightedge in the muzzle end on the lower surface of the bore. If a parallel straightedge is not available, a single-sided straightedge may be wedged against the top of the bore with wooden wedges. The straightedge must be exactly in the middle of the bore and not sprung or distorted by the wedges.

(2) Place a level or the gunner's quadrant on the protruding end of the straightedge and bring the gun in an exactly horizontal position.

(3) Transfer the level or quadrant to the leveling plates and remove metal from the plate toward which the bubble moves until the bubble is centered exactly. Maintain the original level at right angle to the line of correction.

(4) A flat plate with a true surface large enough to cover both leveling plates and lightly coated with prussian blue or red lead should be used to detect high spots and insure the entire surface of each plate to be true, one with the other.

16. Recoil mechanism.—*a. Scope of maintenance by ordnance maintenance personnel.*—For the proper field maintenance of 155-mm gun recoil mechanism M1, ordnance maintenance personnel may dismount, disassemble, repair, and reassemble any part of the replenisher, the counterrecoil cylinder front head, the filling and drain valve housing and parts, and the oil index packing as described in this paragraph. It is absolutely forbidden to remove any other cylinder head or any stuffing boxes. Under no conditions will dis-

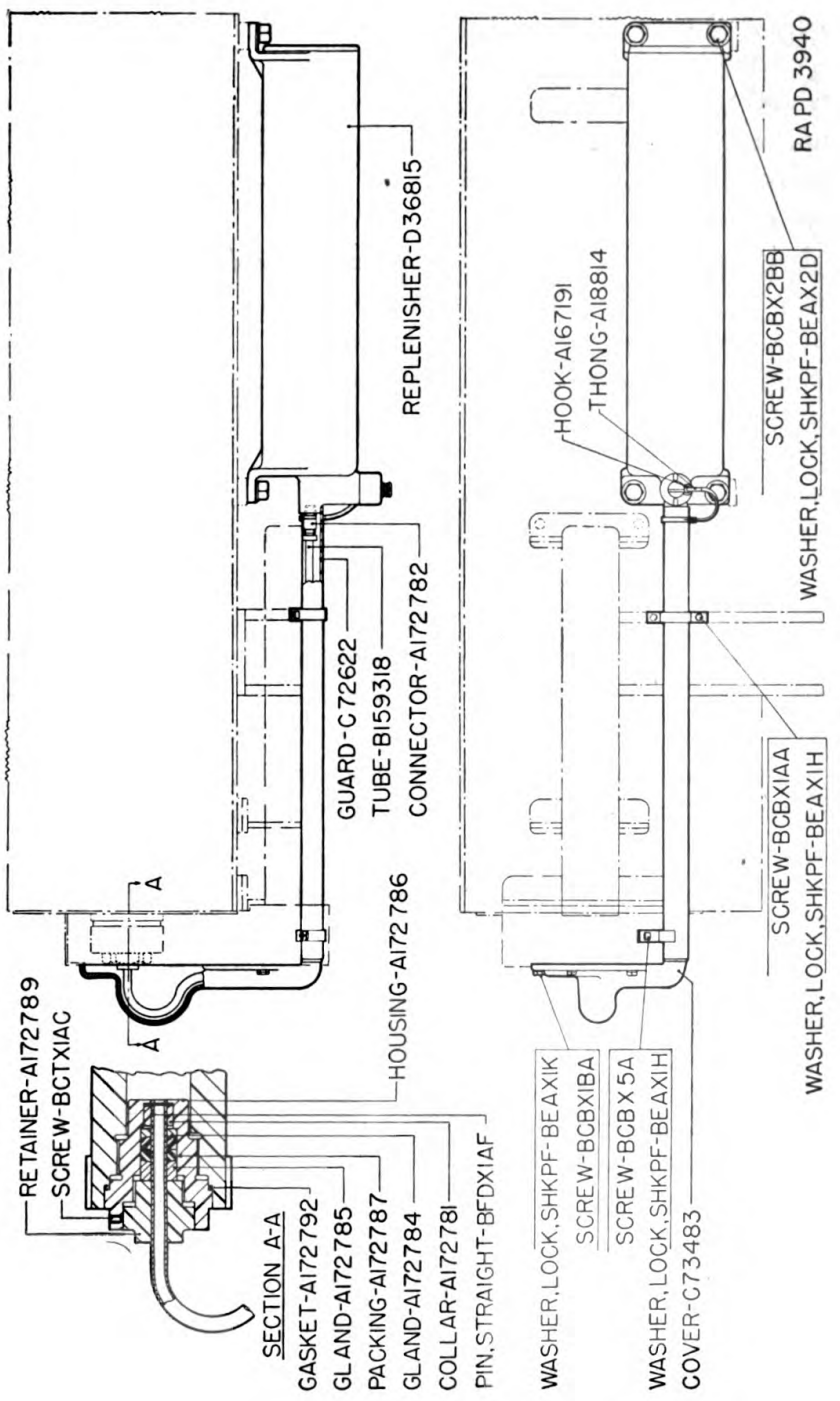


FIGURE 33.—Replenisher and connections.

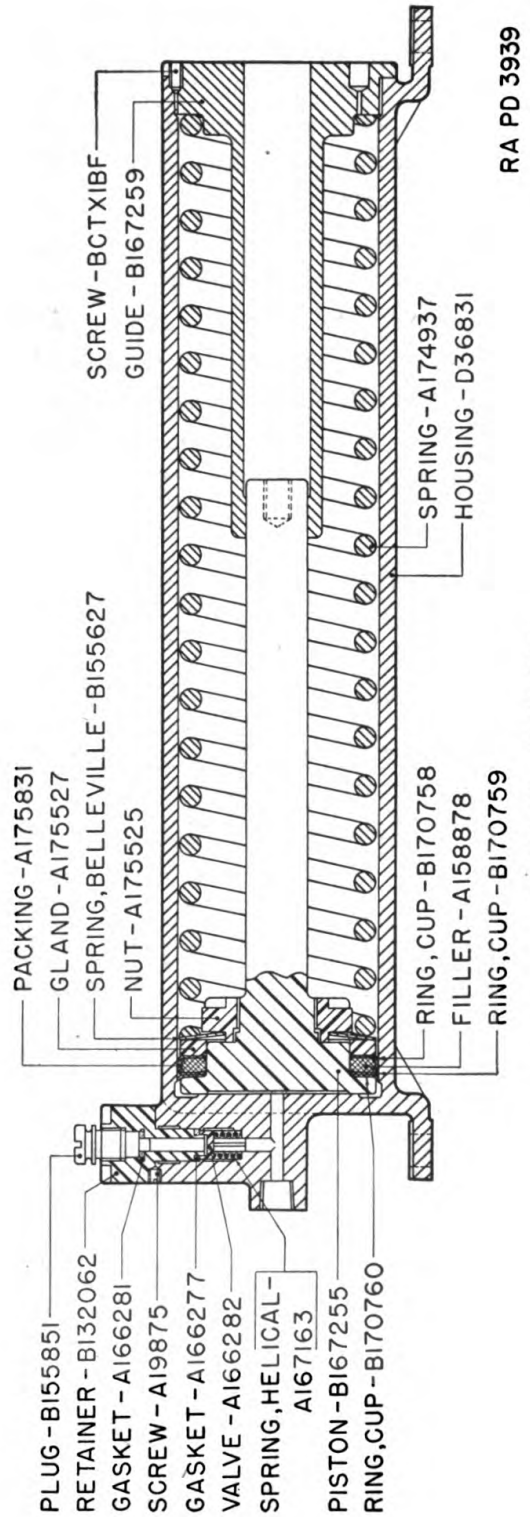


FIGURE 34.—Replenisher.

mounting, assembling, or repair work of any description be permitted on *any* part of the recoil mechanism except by ordnance personnel. Complete disassembly of the mechanism requires special facilities such as are available at base repair shops.

b. Disassembly of the replenisher.—(1) Release the reserve oil in the replenisher. Disassemble the guard (C72622) and tube (B159318) (fig. 33) from the replenisher. Remove the screw retaining the replenisher to the cradle. Fit the assembly beneath the spindle of a drill press with the front end up. Bear down on the replenisher piston guide (B167259) (fig. 34) with the drill press spindle as the guide is unscrewed from the cylinder, so that expansion of the spring will not damage the threads of the cylinder or guide as the guide is unscrewed from the cylinder. Withdraw the piston

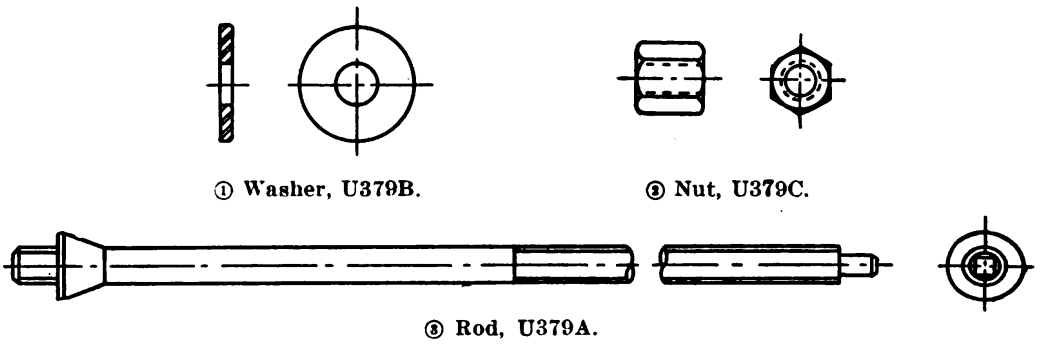


FIGURE 35.—Replenisher piston extractor.

from the replenisher cylinder by means of the replenisher piston extractor (fig. 35). Examine the piston to determine if it is necessary to replace the packing. If the piston is held in a vise for replacing the packing, lead or copper jaws must be used in the vise.

(2) If a drill press is not available, the following procedure should be observed: to disassemble the replenisher piston, the replenisher cylinder being dismounted, remove the 6-mm locking screw from the replenisher piston guide. Screw the short threaded end of the rod of the replenisher piston extractor fully into the rear end of the replenisher piston and screw the washer and nut against the rear of the guide. With the face spanner wrench, unscrew the guide from the cylinder and support it while backing off the nut of the extractor, which will allow the spring to expand until the load upon it is so reduced that the extractor may be unscrewed from the piston stem and the guide and spring taken off. Reverse the guide and hold it against the rear end of the replenisher cylinder. Pass the extractor rod through the washer and again screw it into the

rear end of the replenisher piston. Operate the extractor nut to draw the piston to the rear end of the cylinder, using wooden blocks or washers to lengthen the guide sufficiently. Remove the extractor and back off the replenisher piston nut sufficiently until the compression on the rubber packing is relieved. Never remove the piston from the cylinder or attempt to enter it with the nut drawn up tight. Protect the replenisher piston guide, especially the small end, from any damage during the extraction of the piston.

(3) The thin replenisher cylinder wall is often damaged by lifting slings. Slings, if used, should be placed so that they will not bear directly on the cylinder wall. The replenisher cylinder should never be struck with a hammer to jar the piston when it is stuck.

c. Assembly of the replenisher.—(1) Assemble the filler (A158878), packing (A175831), gland (A175527), and spring (B155627); and screw the nut (A175525) lightly against the Belleville spring. Coat the packing lightly with grease, O. D., No. 0. Put the piston head into the replenisher cylinder and take up on the nut until it bears against the face of the piston head. Push the piston into the cylinder until the piston head contacts the end of the cylinder bore. Place the spring (A174937) in the bore of the cylinder and insert the replenisher piston guide. Place this assembly beneath the spindle of a drill press and compress the spring until it is possible to screw the threads of the guide into the threads of the cylinder. When the flange portion of the guide is in contact with the cylinder, assemble the safety set screw (BCTX1BF). Attach the replenisher to the cradle.

(2) Normal travel of the replenisher piston is 105-mm (4.13 inches); therefore, the normal working zone of travel is from the front of the bore back to 370-mm (14.56 inches) from the rear end.

(3) After any repairs to the replenisher piston the recoil system should be filled with oil and allowed to stand for 10 hours, after which the guide and spring will be removed to note the amount of oil which has passed the piston. Clear oil indicates a leak and requires readjustment or replacement of packings.

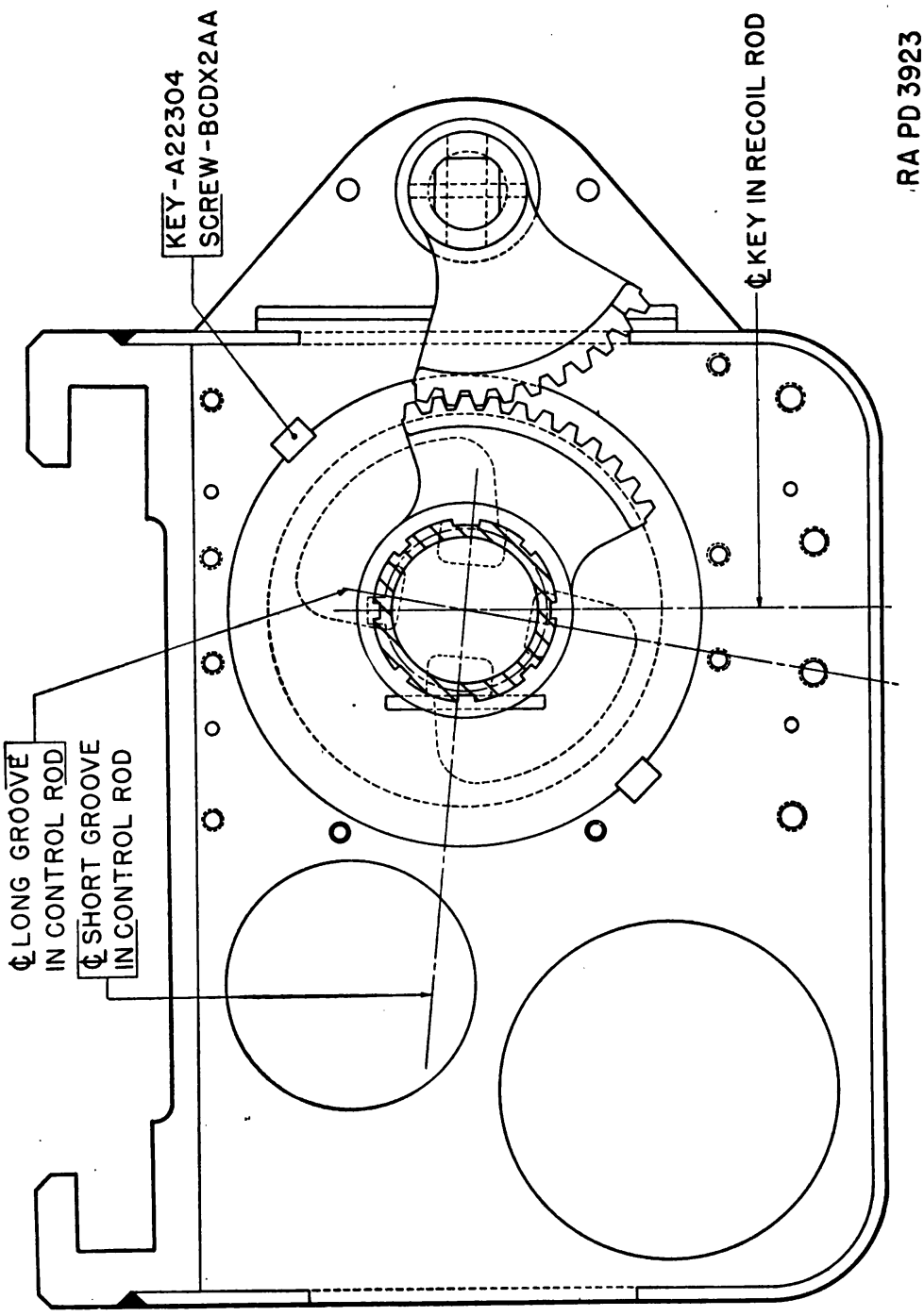


FIGURE 36.—Variable recoil mechanism—0° elevation.

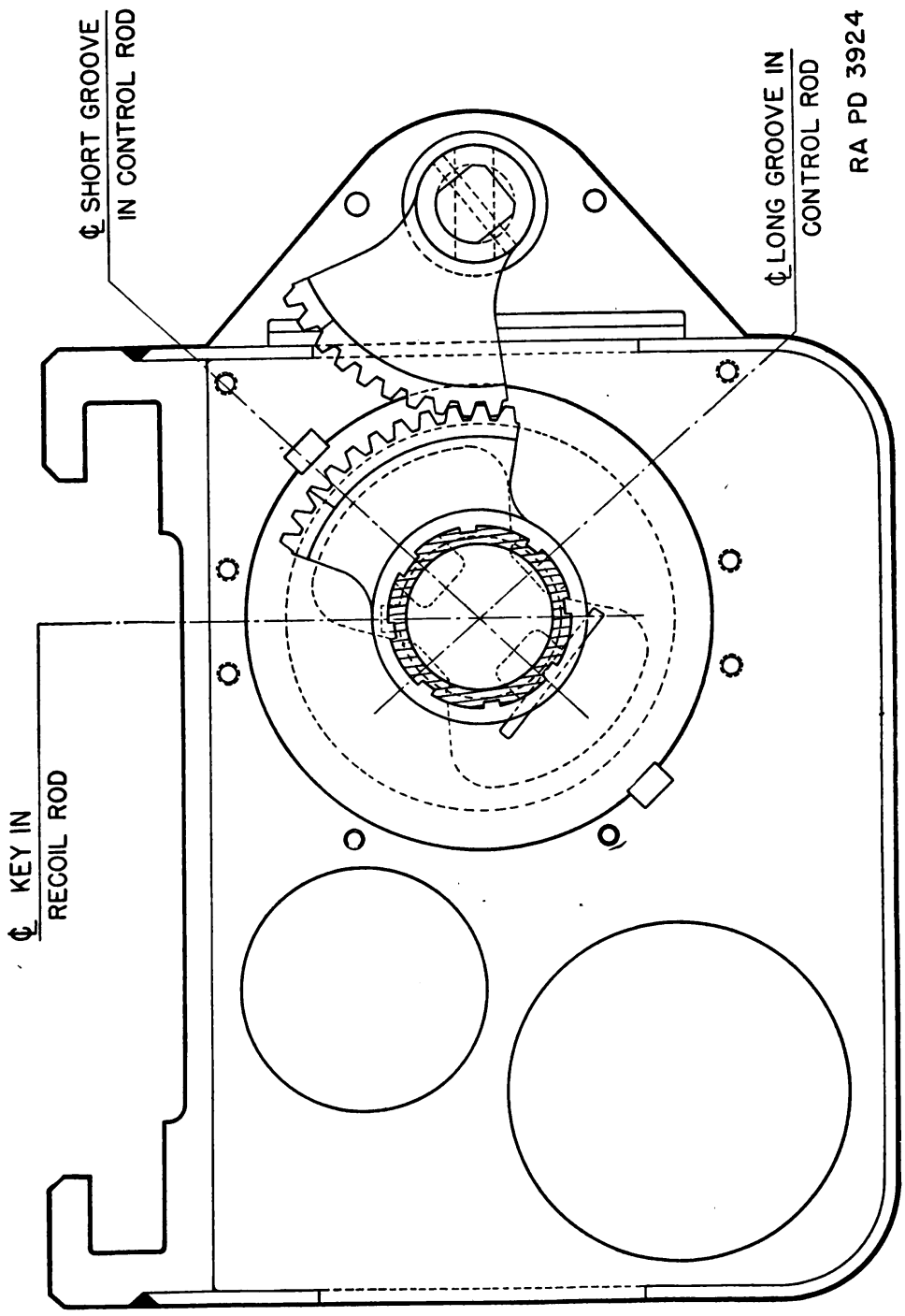


FIGURE 37.—Variable recoil mechanism—65° elevation.

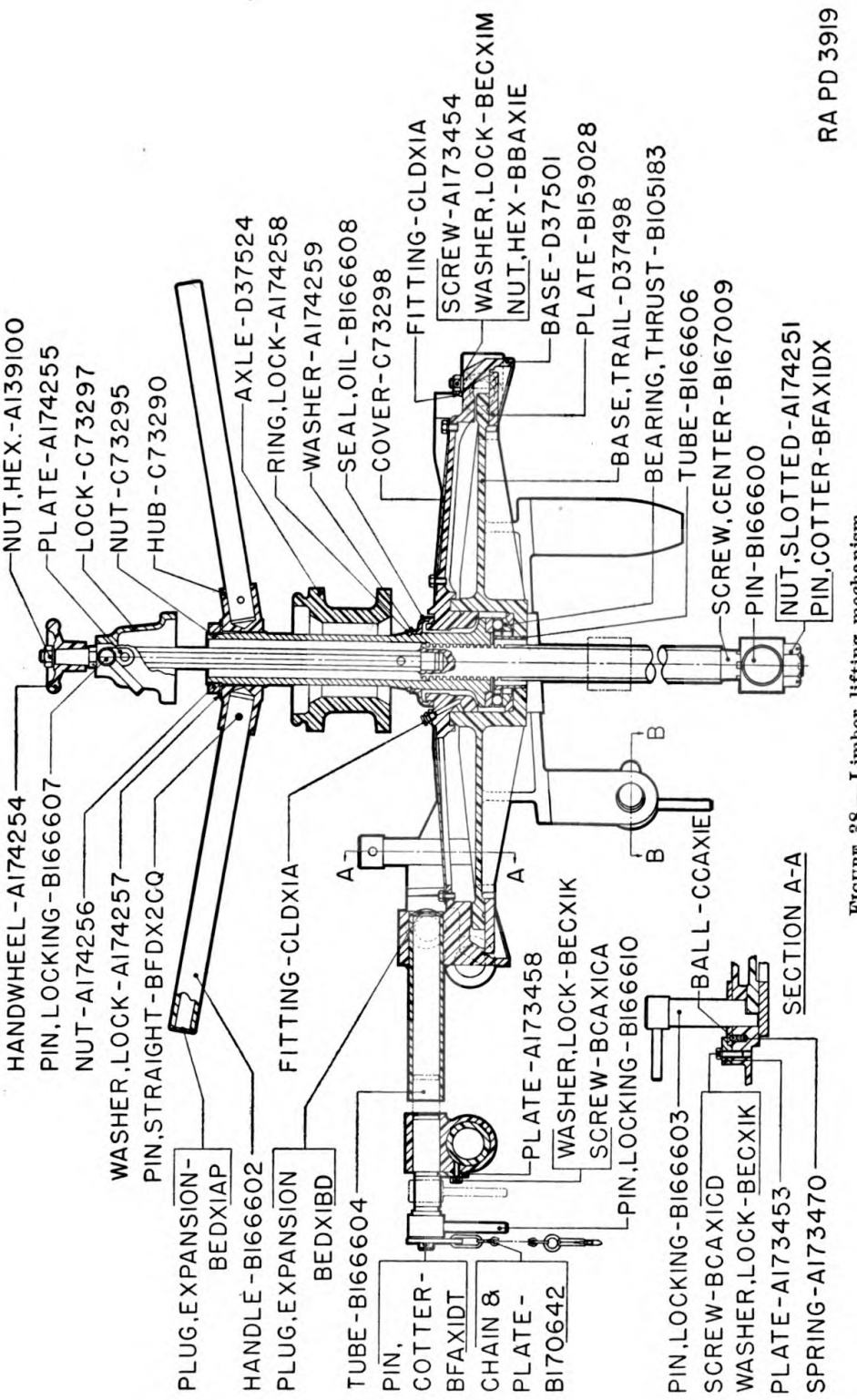


FIGURE 38.—Limber lifting mechanism.

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

a. Cleaning, preserving, and lubricating materials ..... SNL K–1

b. Matériel, 155-mm gun M1 ..... SNL D–24

c. Tools, special, repair, for heavy field and antiaircraft artillery ..... SNL D–14

d. Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" ..... OPSI

2. Explanatory publications.

a. Cleaning, preserving, and lubricating materials ..... TM 9–850

b. 155-mm gun matériel M1 ..... TM 9–350

c. Ordnance maintenance procedure, matériel inspection and repair ..... TM 9–1100

d. Maintenance.

Electric and oxyacetylene welding ..... OFSB 5–2

Maintenance of matériel in the hands of troops ..... OFSB 4–1

Ordnance maintenance, star-gaging equipment and gutta-percha impressions (now published as supplement to SNL N–9) ..... TM 9–1860

e. Miscellaneous.

Artillery Gun Book ..... O. O. Form 5825

Ordnance Proof Manual (Proof of guns and carriages).

f. Ordnance drawings.

155-mm gun M1 ..... Class 53, Division 89

155-mm gun M1A1 ..... Class 53, Division 89

155-mm gun carriage M1 ..... Class 3, Division 185

155-mm gun carriage M1A1 ..... Class 3, Division 185

155-mm gun recoil mechanism M1_____ Class 3, Division 186
Bogie_____ D379899
Heavy carriage limber M2_____ Class 3, Division 188

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